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NATIONAL DAM SAFETY PROGRAM. UPPER NORTON RESERVOIR DAM (VA 195--ETC(U)
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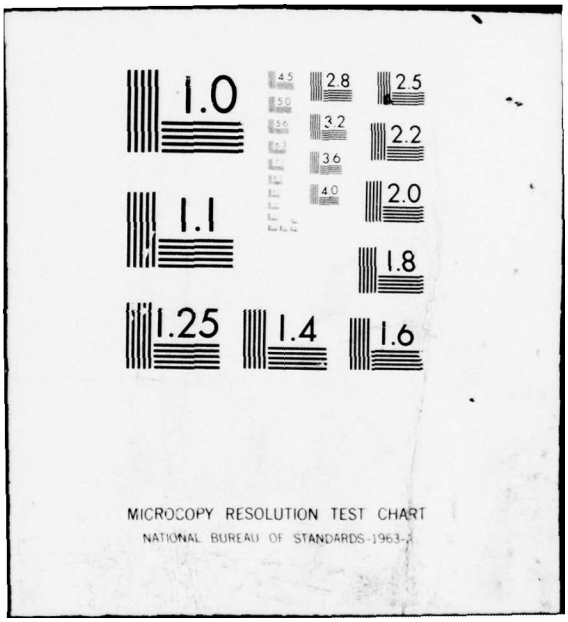
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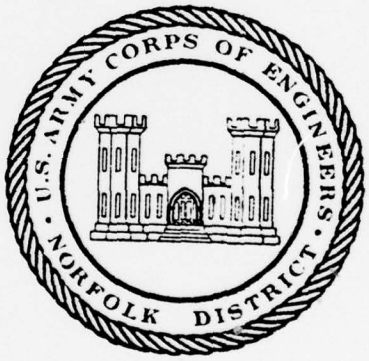
TENNESSEE RIVER BASIN

Name Of Dam: UPPER NORTON RESERVOIR DAM
Location: WISE COUNTY, VIRGINIA
Inventory Number: VA 19508

LEVEL II

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM



PREPARED FOR

NORFOLK DISTRICT CORPS OF ENGINEERS
803 FRONT STREET
NORFOLK, VIRGINIA 23510

BY

GILBERT ASSOCIATES, INC.

AUGUST, 1978

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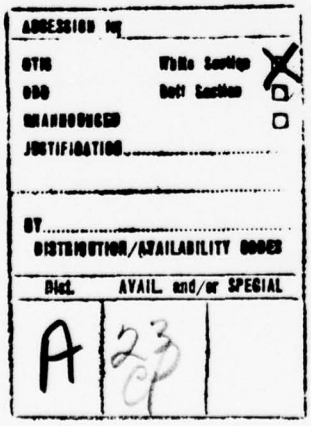
20. Abstract

Pursuant to Public Law 92-367, Phase I Inspection Reports are prepared under guidance contained in the recommended guidelines for safety inspection of dams, published by the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general conditions of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

Based upon the field conditions at the time of the field inspection and all available engineering data, the Phase I report addresses the hydraulic, hydrologic, geologic, geotechnic, and structural aspects of the dam. The engineering techniques employed give a reasonably accurate assessment of the conditions of the dam. It should be realized that certain engineering aspects cannot be fully analyzed during a Phase I inspection. Assessment and remedial measures in the report include the requirements of additional indepth study when necessary.

Phase I reports include project information of the dam and appurtenances, all existing engineering data, operational procedures, hydraulic/hydrologic data of the watershed, dam stability, visual inspection report and an assessment including required remedial measures.

LEVEL II



PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

CONTENTS

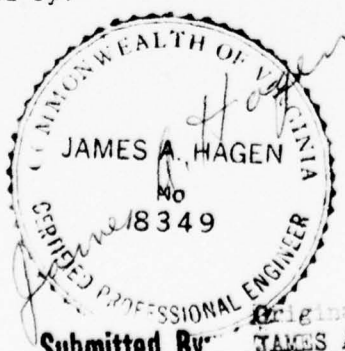
PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Upper Norton Reservoir Dam
State:	Virginia
County:	Wise
USGS Quadrangle Sheet:	Norton, Virginia
Stream:	Benges Branch - Powell River

This dam is a 78-foot high, 340-foot long earth dam with an impervious core. It has a single concrete chute type spillway founded on bedrock cut along the rather steep left abutment. The dam is used for secondary storage of water above the main reservoir for the city of Norton, Virginia. While the dam does not appear to pose an imminent hazard, there are several concerns which could lead to hazardous conditions if they are not corrected, and which should, therefore, be given immediate attention. (See Appendix VIII, Conditions.)

The spillway capacity is adequate to pass 69 percent of the probable maximum flood (PMF) without overtopping the dam. The spillway will pass one-half of the PMF with 1.0 foot of freeboard. It is recommended that in periods of unusually high runoff the owner provide around-the-clock surveillance of the dam and have a contingency plan for warning downstream residents in the event of overtopping. Consideration should be given in the future to enlarging the spillway to pass the PMF. Stability calculations were not available; however, the dam has withstood previous severe storms with no apparent significant damage. A minor slide occurred in 1977 in the reservoir area not far from the spillway weir. A study of the reservoir slopes should be commenced within 30 days. Further information should be obtained by the owner, within 30 days, to evaluate the stability of the slopes in the vicinity of the weir and spillway. The source of minor seepage at the spillway-embankment junction should be investigated within 30 days, and minor areas of erosion near the toe should be periodically inspected to determine if the erosion is progressing. There is excessive tree growth to heights of 30 feet on the upstream and downstream slopes of the dam. The trees should be removed within 30 days and the resultant disturbed areas repaired immediately thereafter. Because the properties of the dam embankment and foundation are unknown, a soil boring and testing program should be commenced within 90 days to evaluate the long-term stability of the dam.

Prepared by:



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Submitted By: _____

APPROVED: **Original signed by:**

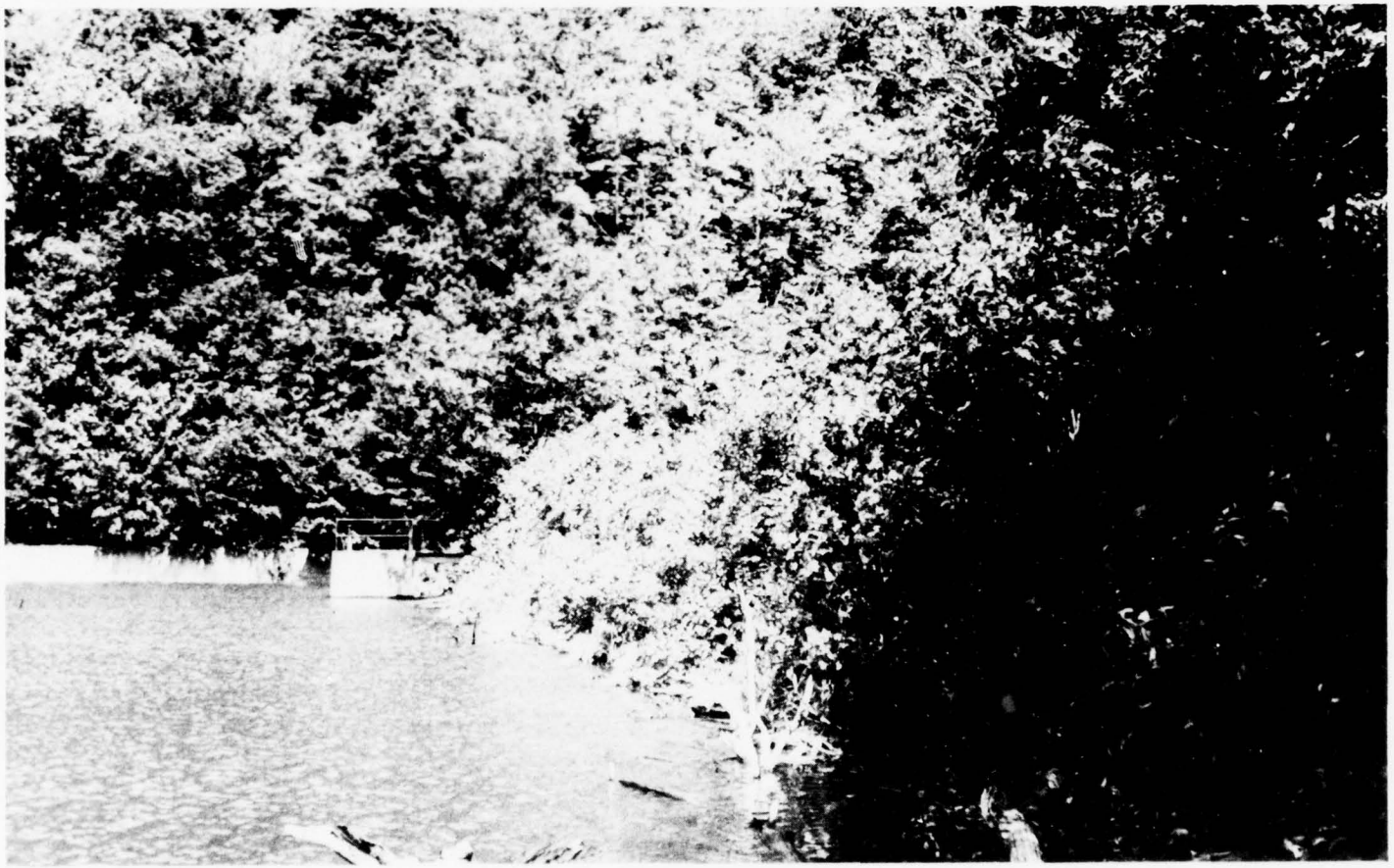
Douglas L. Haller

Douglas L. Haller
Colonel, Corps of Engineers
District Engineer

Date: **23 AUG 1978**

Original signed by
ZANE M. GOODWIN

Recomended By: _____



June 1978

OVERALL VIEW OF UPPER NORTON RESERVOIR DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
NAME OF DAM: Upper Norton Reservoir Dam ID #: VA 19508

SECTION 1 - PROJECT INFORMATION

1.1 General

1.1.1 Authority: Public Law 92-367, 8 August 1972, authorized the Secretary of the Army, through the U.S. Corps of Engineers to initiate a national program of safety inspections of non-Federal dams throughout the United States. The Norfolk District of the U.S. Corps of Engineers has been assigned the responsibility of the inspection of the dams in the Commonwealth of Virginia. Gilbert Associates, Inc. has entered into a contract with the Norfolk District to inspect this dam, Gilbert Work Order 06-7250-004.

1.1.2 Purpose of Inspection: The purpose is to conduct a Phase I inspection according to the Recommended Guidelines for Safety Inspection of Dams (Reference 1 of Appendix VII) and contract requirements between Gilbert Associates, Inc. and the Corps of Engineers. The objectives are to expeditiously identify whether this dam apparently poses an immediate threat to human life or property, and to recommend future studies and/or any obvious remedial actions that may be indicated by the inspection.

1.2 Project Description

1.2.1 Dam and Appurtenances: The Upper Norton Reservoir Dam is an earthfill structure about 340 feet long and 78 feet high. The top of the dam is 12 feet wide and is at elevation 3292.5 feet m.s.l. Side slopes are 2.5 horizontal to 1 vertical on the downstream side and 3 horizontal to 1 vertical on the reservoir side.

The spillway is an ungated, reinforced concrete drop inlet, side-channel type with an inlet weir length of 62 feet at an elevation of 3287.5 feet m.s.l. providing 5 feet of freeboard. The reinforced concrete spillway channel is excavated in the original ground and supported on bedrock along the left abutment, discharging about 30 feet downstream of the toe of the dam into a shallow stilling basin.

The dam also has a 30-inch square box culvert, serving as an outlet passing under the dam and an intermediate level inlet controlled by valves in a concrete shaft with valve control stems extending to manual operators at the level of the crest of the dam.

1.2.2 Location: The Upper Norton Reservoir Dam is located in the Jefferson National Forest on the Benges Branch of the Powell River about 1 mile south of the city of Norton, Virginia.

1.2.3 Size Classification: Because of its height of 78 feet, the dam is classified as an "intermediate" size structure in accordance with Section 2.1.1 of Reference 1 of Appendix VII.

1.2.4 Hazard Classification: This dam is located upstream of Lower Norton Reservoir; however, it must be assumed that the water will either flow directly over that dam or cause it to fail so the water would continue to the populated area downstream. The dam should, therefore, be classified as having a high hazard classification in accordance with guidelines contained in Section 2.1.2 of Reference 1 of Appendix VII. The hazard classification used to categorize dams is a function of location relative to property and people only and has nothing to do with its stability or probability of failure.

1.2.5 Ownership: City of Norton, Virginia.

1.2.6 Purpose: Water supply to the city of Norton and fishing with electric motors only.

1.2.7 Design and Construction History: The dam was designed by the Chester Engineers of Pittsburgh, Pennsylvania, about 1956. Reportedly, the construction was completed in 1958 or 1959; however, no construction documents were provided by the owner at the time of inspection. It was reported by a local resident that the material for the dam was hauled in from some distance and compacted with sheepsfoot rollers. There has apparently been no construction or significant revisions since original construction; however, an informal design for drainage collection at several seepage areas near the toe of the dam is shown on the copy of the drawings on file with the city of Norton (Appendix I).

1.2.8 Normal Operational Procedure: During periods of excessive runoff, the outflow is uncontrolled and all discharge passes over the weir and into the spillway. During very dry periods, when the Lower Norton Reservoir is unable to supply adequate water for the city of Norton, the valve at elevation 3256 feet would be opened to release stored water to the lower reservoir. According to the owner's representative, only during extreme drought or to affect repairs would the lower valve at elevation 3226 feet be used. This valve could be used to drain the entire reservoir.

1.3 Pertinent Data

1.3.1 Drainage Area: 0.69 square miles

1.3.2 Discharge at Dam Site: Maximum flood at dam site not known. Principal spillway with pool level at top of dam - 2,300 c.f.s.

1.3.3 Dam and Reservoir Data: Pertinent data on the dam and reservoir is shown in Table 1.1:

TABLE 1.1 DAM AND RESERVOIR DATA

Item	Elevation feet m.s.l.	Water Surface Area-acres	Reservoir Capacity Acre-feet	Watershed inches	Length miles
Top of Dam	3292.5	17.5	277	7.5	0.2
Spillway Crest	3287.5	11.0	202	5.5	0.2
Streambed at Dam	3215	0	0	0	0

For other dam construction details see the drawings in Appendix I. Maximum tailwater elevation 3220.0 feet m.s.l.

SECTION 2 - ENGINEERING DATA

2.1 Design: The dam was designed by the Chester Engineers of Pittsburgh, Pennsylvania. The design drawings are attached in Appendix I. The available specifications show that: cement groutmix (maximum three parts of cement and two parts of water by volume) was pumped into 2-inch diameter drilled holes under variable pressures of up to 100 p.s.i. as a measure to reduce potential seepage; the gradation of the filter material was determined by the engineer, probably in the field; and as far as possible, suitable materials from the reservoir area were borrowed, and the remainder was hauled from other areas, to construct the dam embankment. A description of the dam embankment materials and their placement is given in the specifications, in Appendix VI-A, indicating the dam is constructed of three zones with a core containing 50 percent clay (zone A), an upstream layer consisting of 30 percent clay (zone B), and a downstream layer consisting of random compactible excavated material. The non-clay portion of the fill is described as a soft shale. No other design data was made available at the time of this inspection.

2.2 Construction: Only three as-built drawings were available from the Chester Engineers (see Appendix I). The owner's representative, the City Manager, was not in office when the dam was constructed and could not locate other records of the construction.

2.3 Operation: Operation is automatic and no gates are normally used. Records of water levels measured down from the overflow weir crest have been made monthly and are kept at the Norton water treatment plant for the period since June 1975. They indicate the reservoir has been full or overflowing about 50 percent of the time, and has only been as low as elevation 3270 once during that time. The records are not completely adequate because the water depth flowing over the spillway is not recorded. Reportedly, during the last several years the rainfall has been adequate so there was no need to operate the valves, which would increase the flow to the lower reservoir.

2.4 Evaluation: The available as-built drawings (Appendix I) show that the dam was constructed before October 1957 contrary to the local information that it was completed in 1958-1959. A few discrepancies also exist on these drawings; readily seen are the incomplete true top of the rock line and the absence of the grouting information between Stations 2+70 and 3+35 (Appendix I). The specifications (Appendix VI-A) describe the various fill soils very vaguely. Also, the soil overburden in the logs of borings along the dam axis is described as just "Earth" (Appendix I). Thus, the available data on this dam is incomplete.

Among the missing items are:

a. Complete as-built drawings and construction records.

b. Design high water elevation and maximum design flow over the spillway.

c. A record of the maximum water elevation in the reservoir.

d. Seepage and stability analyses.

e. Subsurface exploration report including borrow area investigations.

f. Test reports of concrete and soils during construction.

g. Pre-grouting and post-grouting permeability tests.

h. The name(s) of the contractor(s) and dates of construction.

i. Inspection reports during or since construction.

SECTION 3 - VISUAL INSPECTION

3.1 Findings

3.1.1 General: The dam site can be reached by four-wheel drive vehicles and most maintenance equipment. For photos see Appendix II.

3.1.2.1 Dam: Significant portions of both the upstream and downstream slopes were covered with a dense tree growth. Many trees were 30 to 40 feet tall with trunk diameters up to 9 inches. No areas of significant settlement were observed. Several small erosion gullies up to 6 inches deep were observed near the downstream toe; the gullies were vegetated except for a few bare spots. The surficial embankment soil was brown, silty, fine sand with a trace to little clay. The visible upstream riprap was generally slab shaped siltstone and/or sandstone rock 2 to 4 inches thick, and varying in width and length from 2 inches up to 3 feet. Much of the riprap was covered with vegetation and there was some minor dislocation of stones as shown in the photographs. A portion of the riprap adjacent to the spillway was covered with cement grout. The slopes and dam crest were generally uniform and in agreement with the slopes and dimensions shown on the design drawings.

3.1.2.2 Seepage: Soggy and spongy areas were noticed at several locations within the lower 50 feet measured from the toe along the downstream slope of the dam. Heavy vegetation including an excessive number of trees and tall bushes and surface wetness, probably resulting from a heavy rainfall the night before the inspection, made the visual inspection of seepage areas virtually impossible. However, a small leak was observed at the junction of the embankment with the spillway wall near a vertical joint. This water was flowing toward and over the left wingwall of the 30-inch box culvert at a rate of about 5 gallons per minute and was clear. Water was flowing down the spillway to a depth of several inches at the time of this inspection. Seepage in this area had been noted several years ago and was sketched on the city's plan drawing with a conceptual plan for identifying and controlling the seepage. This work was never done to the knowledge of the City Manager or his Maintenance Foreman.

3.1.2.3 Appurtenant Structures: The overflow weir and the spillway dimensions that were checked agreed with the plans. No significant displacement, tilting, or cracking of these structures was observed except for a relative displacement of about 1-1/2 inches at the top of the right (damside) wall of the spillway at station 0 + 50 on the plans. Expansion joint material was partially extruded at several vertical joints in the spillway channel. There was some surface spalling or scaling of the concrete at the discharge point of the 30-inch culvert. Excessive tree growth was observed behind the spillway walls.

3.1.3 Reservoir Area: The reservoir shoreline was densely wooded and no major active landslide areas could be seen. However, a small shallow slide (see photos - Appendix II) was observed on the west shoreline about 400 feet from the spillway weir. The width of the slide area was approximately 25 feet, and its depth 3 to 4 feet. The length of the slide was approximately 60 feet upwards from the waterline, with the bank sloping approximately 2.5 horizontal to 1.0 vertical. The exposed material at the top of the slide area was visually identified as weathered soft shale comprised predominantly of silt with little clay. The clay fraction appears to be lean. The slide appeared to have occurred recently. This was confirmed by the City Manager who reported the slide occurred in 1977. Similar material was observed exposed along the west shore near the overflow weir. The shoreline slopes on the east side were relatively flatter and stable.

3.1.4 Downstream Channel: The channel near the toe of the dam is covered with much vegetation. There is a dumped rock dam which is apparently intended to form a stilling basin during periods of high discharge through the spillway. The side slopes were densely wooded but relatively much flatter than along the reservoir and hence more stable. The reservoir formed by Lower Norton Reservoir was about 200 feet from the toe of this dam.

3.2 Evaluation: The dam appeared to have been built in accordance with the design drawings and does not pose an observable immediate hazard. However, the source of leakage adjacent to the spillway near the toe should be ascertained. Tree growth on portions of the upstream and downstream slopes and behind the spillway walls is excessive. The existence of a slide in the reservoir area indicates a potential for sliding exists in the critical slopes above the spillway.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures: There are apparently no formal, recorded operating procedures for this dam. As reported by the City Manager, a valve at elevation 3256 feet with a riser to the surface and accessible from the dam would be opened should the Lower Norton Reservoir become depleted and water would flow through the 30-inch box culvert to Lower Norton Reservoir to eventually serve as the city water supply.

4.2 Maintenance: There is no maintenance procedure for this dam or for the operating facilities at the dam other than periodically cutting the grass and brush on the crest of the dam.

4.3 Description of Any Warning System in Effect: There is no formal warning system at this dam. There is a telephone at the filtration plant about 1 mile downstream of the dam. If a hazardous condition became known to the filtration plant operator, he could attempt to notify the police by telephone. The police would in turn notify the County Civil Defense and Emergency Operations Center (EOC).

4.4 Evaluation: Periodic inspection and maintenance of the dam and operating facilities should be performed.

SECTION 5 - HYDRAULIC/HYDROLOGIC DESIGN

5.1 Design: No hydraulic and hydrologic design information is available on the design of the dam and appurtenant structures.

5.2 Hydrologic Records: None.

5.3 Flood Experience: According to the owner's maintenance and caretaker crew, the dam has never been overtopped and there was no damage during the 1977 spring flood. According to local people, the flood of spring 1977 was the highest flood of the near past. The intensity and recurrence interval of the flood is not known. This flood occurred because of a rainfall of 6.21 inches in a 26-hour period, as recorded at the rainfall station in Wise, Virginia, about 10 miles away.

5.4 Flood Potential: The design flood of the dam is not known. However, various flood hydrographs were routed through the reservoir and the results are described in paragraph 5.6.

5.5 Reservoir Regulation: Important design features of the dam and reservoir are given in Table 5.1.

There are no specific reservoir regulation procedures. During the period when the reservoir is at its full level, the flow passes over the spillway automatically into the lower reservoir. However, during low water levels, the gate valve at elevation 3256 feet is operated to release water.

5.6 Overtopping Potential: The PMF, one-half the PMF, and the 100-year flood hydrographs were developed by Gilbert Associates, Inc. for the Upper Norton Reservoir drainage basin and routed through the reservoir. Table 5.1 summarizes the result of this analysis.

The hydrographs were developed and routed by using the HEC-1 computer program (Reference 3 of Appendix VII) and appropriate precipitation, unit hydrograph, and storage volume versus outflow data as input. The analysis pertains to present day conditions in the water shed and the effects of future development on hydrology has not been considered. The triangular unit hydrograph was developed from the drainage area and estimated time to peak (Reference 4 of Appendix VII). Probable maximum precipitation and 100-year precipitation data were obtained from U.S. Weather Bureau publications (References 5 and 6 of Appendix VII). The appropriate reduction factor (20 percent) was applied to the PMP in accordance with Corps of Engineers directive and guidelines. Design drawings were used to compute the storage-outflow relation with the emergency spillway functioning as a broad-crested weir. Losses were estimated at an initial loss of 1.0 inch and a constant loss rate of 0.3 inch/hour.

TABLE 5.1 - RESERVOIR PERFORMANCE

Item	Flood Hydrograph		
	100-Year	1/2 PMF	PMF
Peak Flow, c.f.s.			
Inflow	1050	1990	3980
Outflow	824	1640	3810
Peak Elevation, feet m.s.l.	3290.0	3291.5	3293.3
Emergency Spillway			
Depth of Flow, feet (a)	1.8	2.8	4.1
Average Velocity, f.p.s.	7.6	9.4	11.3
Dam Overtopping			
Depth of Flow, feet (a)	-	-	0.6
Average Velocity, f.p.s.	-	-	4.7
Tailwater Elevation		Not available	Not available

Note:
(a) Critical depths.

5.7 Reservoir Emptying Potential: The 12-inch gate valve in the lower box culvert could permit the reservoir to draw down at the rate of about 30 c.f.s. at spillway crest elevation and dewater the reservoir in 4-1/2 days. It is not known whether the valve is operable or not.

5.8 Evaluation: The results of analyses described in paragraph 5.6 indicate that the emergency spillway is not capable of passing the routed PMF without overtopping the dam. The maximum water level will be approximately 0.6 feet above the top of the dam for a period of about 50 minutes. The one-half PMF is passed by the reservoir with 1.0 foot of freeboard at the peak water surface elevation. The spillway capacity is adequate to pass 69 percent of PMF without overtopping the dam.

SECTION 6 - DAM STABILITY

6.1 Stability Analysis: No record of any stability analysis is available for this earth dam. The information from the available records and visual inspection is not adequate to perform a stability analysis. The description of the constituent embankment soils and their properties are inadequate in the records. For example, Class "A" material is described as at least 50 percent clay and the remainder soft shale and Class "B" is described as not less than 30 percent clay and the balance shale. The foundation soil, the thickness of which may be as much as 20 feet to 25 feet at the most critical section, is identified as "earth." Other data, namely those related to the geometry of the dam sections, are adequate and consistent with visual observations. If segregation of the shale and the soil during construction did not occur, and the shale fragments were pulverized and broken properly to form a well-compacted embankment, as stated in the specifications, the embankment apparently has an adequate factor of safety under a probable maximum condition of loading. However, these conditions must be confirmed by properly investigating the embankment and foundation soil properties. The dam's stability has apparently been adequate for preceeding conditions, including a flood in April of 1977.

6.2 Foundation and Abutment: The data in Appendix I shows that the right-abutment slope is flatter than the left-abutment slope (approximately 2-1/2 horizontal to 1 vertical versus 1-1/2 horizontal to 1 vertical). Also, the soil cover on the former is 8 feet to 10 feet thick whereas it is only 5 feet thick on the latter. The soil cover in the valley area varies from 10 feet to 23 feet. The underlying rock, as encountered in the borings along the dam axis, is shale in the valley bottom area, whereas it is sandstone or sandstone follwed by shale on the valley slopes. The rock strata appears to be a Lee Formation, though no coal seam was apparently encountered in the borings. The positive cutoff composed of impervious fill was taken to the rock or a few feet into the rock (see Appendix I). The broken rock strata beneath the impervious cutoff showed no leakage in the hydrostatic testing in the bore holes and were grouted using cement grout-mix. Grouting was done by drilling a single line of holes spaced 5 feet center to center along the dam axis. A sufficiently thick soil cover and the cutoff to the rock are probably effective in reducing the foundation seepage pressures, although complete effectiveness of the grouted curtain is doubtful. The field inspection did not detect settlement or movement of the main embankment, excessive foundation seepage, or unusual abutment conditions. This indicates that the dam and its foundation are functioning properly. According to the City Manager, there has reportedly been no coal mining activity under this dam and never will be.

6.3 Evaluation: The dam and appurtenant structures have been stable under the previous flooding condition. Although the dam is located in the relatively stable Zone 2 on Algermissen's Seismic Risk Map of the United States (1969 edition), pertinent information on the embankment and foundation soil properties should be obtained to analyze the stability of the dam and verify that the conventional safety margins exist as specified in Section 4.4 of Reference 1 of Appendix VII prior to assessing the seismic stability of the dam.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

The assessment, recommendations, and remedial measures contained in this Report are based on the provisions of Appendix VIII, Conditions.

7.1 Dam Assessment: There were no major detrimental findings such as embankment cracking, internal erosion, uneven settlement or significant underseepage, which would indicate an immediate hazardous condition. The dam will pass one-half the PMF with 1.0-foot freeboard on the crest.

However, there are several items of concern listed below:

7.1.1 A minor slope failure had occurred on the reservoir shoreline within several hundred feet of the principal spillway.

7.1.2 There is inadequate information available to evaluate the stability of the slope areas in general, and more specifically the slopes above and adjacent to the spillway.

7.1.3 The results of inflow indicate that the dam will be overtopped by the PMF, but the spillway capacity is adequate to pass 69 percent of the PMF without overtopping the dam.

7.1.4 There is a small quantity (about 5 g.p.m.) of seepage emerging at the junction of the spillway and the embankment near the toe of the dam.

7.1.5 There is excessive tree growth to heights of 30 feet in various areas on both the upstream and downstream slopes of the dam.

7.1.6 There are minor areas of erosion on the downstream face of the dam near the toe.

7.1.7 Information on the properties of the dam embankment and foundation materials is incomplete.

7.2 Recommendations/Remedial Measures: To address the concerns stated above, the following is recommended:

7.2.1 A study of the stability of the reservoir slopes should be performed soon. An aerial inspection may be required as the topography of the area is rugged.

7.2.2 The owner should obtain all existing computations for stability of the slopes adjacent to the spillway of this dam within 30 days of receipt of this Report. The potential for blockage of the spillway inlet by fallen and floating trees as well as slope failures should be investigated commencing within 30 days.

7.2.3 It is recommended that in periods of unusually high runoff, the owner provide around-the-clock surveillance and have a contingency plan to warn downstream residents in the event of overtopping. Also, it is recommended that consideration be given in the future to enlarging the spillway to pass the PMF.

7.2.4 The source of the seepage at the spillway-embankment junction and the erodibility of the contact zones should be investigated with a monitoring program within 90 days. It is further recommended that the owner obtain all existing computations regarding design and allowable seepage through the dam within 60 days of receipt of this Report.

7.2.5 Trees should be removed from the dam embankment within 30 days and the slopes stabilized immediately thereafter. Where large trees and roots are removed, especially on the upstream side, the holes remaining should be immediately filled with a material similar to the surrounding material. On the reservoir side, areas disturbed by tree and root removal should be immediately backfilled and protected by riprap providing slope protection as good as, or better than, the original riprap.

7.2.6 Areas of erosion and seepage should be periodically observed and any seepages measured, at least semi-annually, for changes. If significant changes are noted, the reasons should be investigated immediately and remedial actions taken as indicated. The annual inspection program recommended herein should also include a review of all areas of erosion.

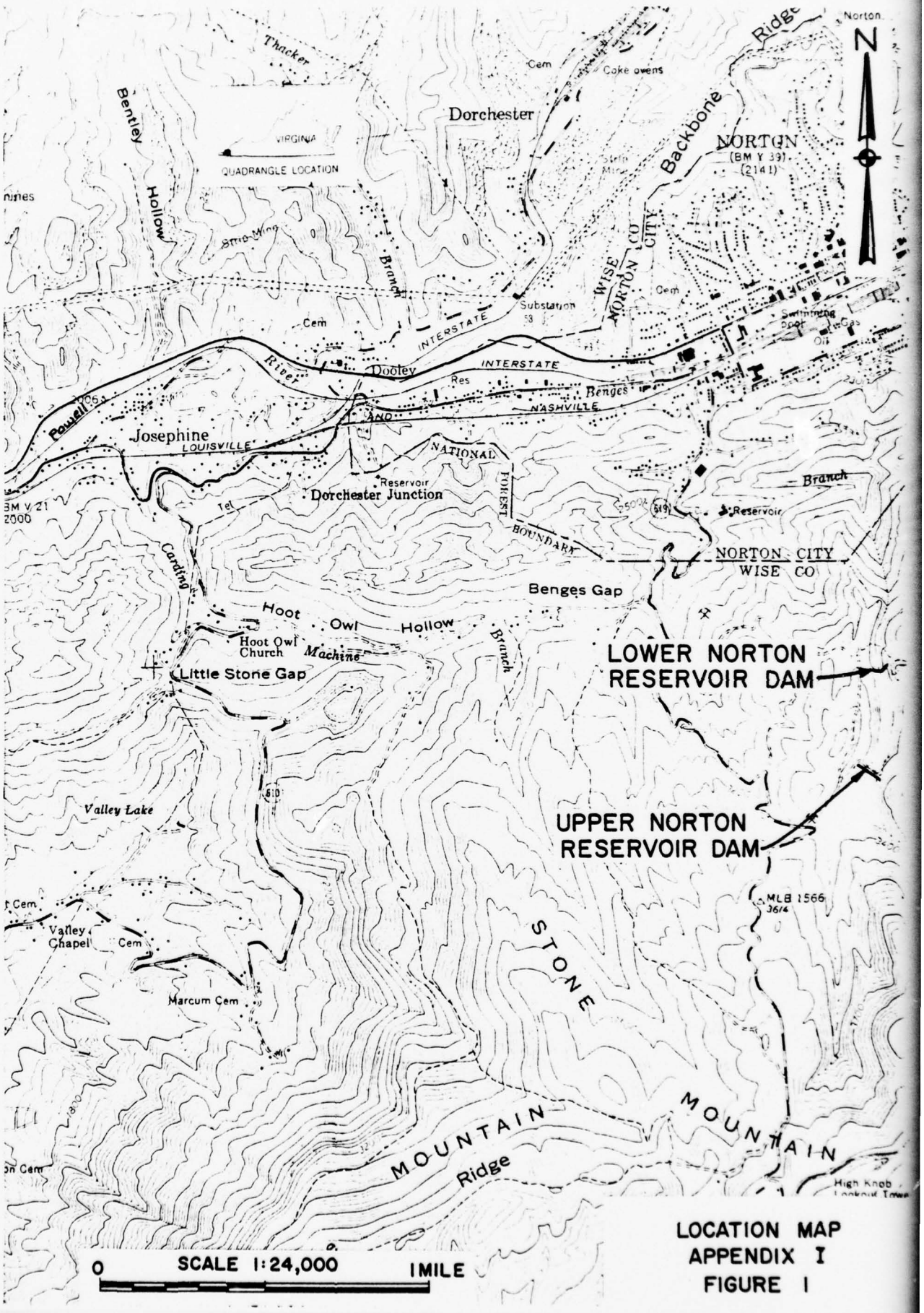
7.2.7 A boring and testing program to evaluate properties of the dam and foundation materials should be commenced within 90 days to properly evaluate the stability of the dam.

7.2.8 It is recommended that a warning system be established for the public safety of the residents of the downstream area. This system should be automatic or manual and operable 24 hours per day.

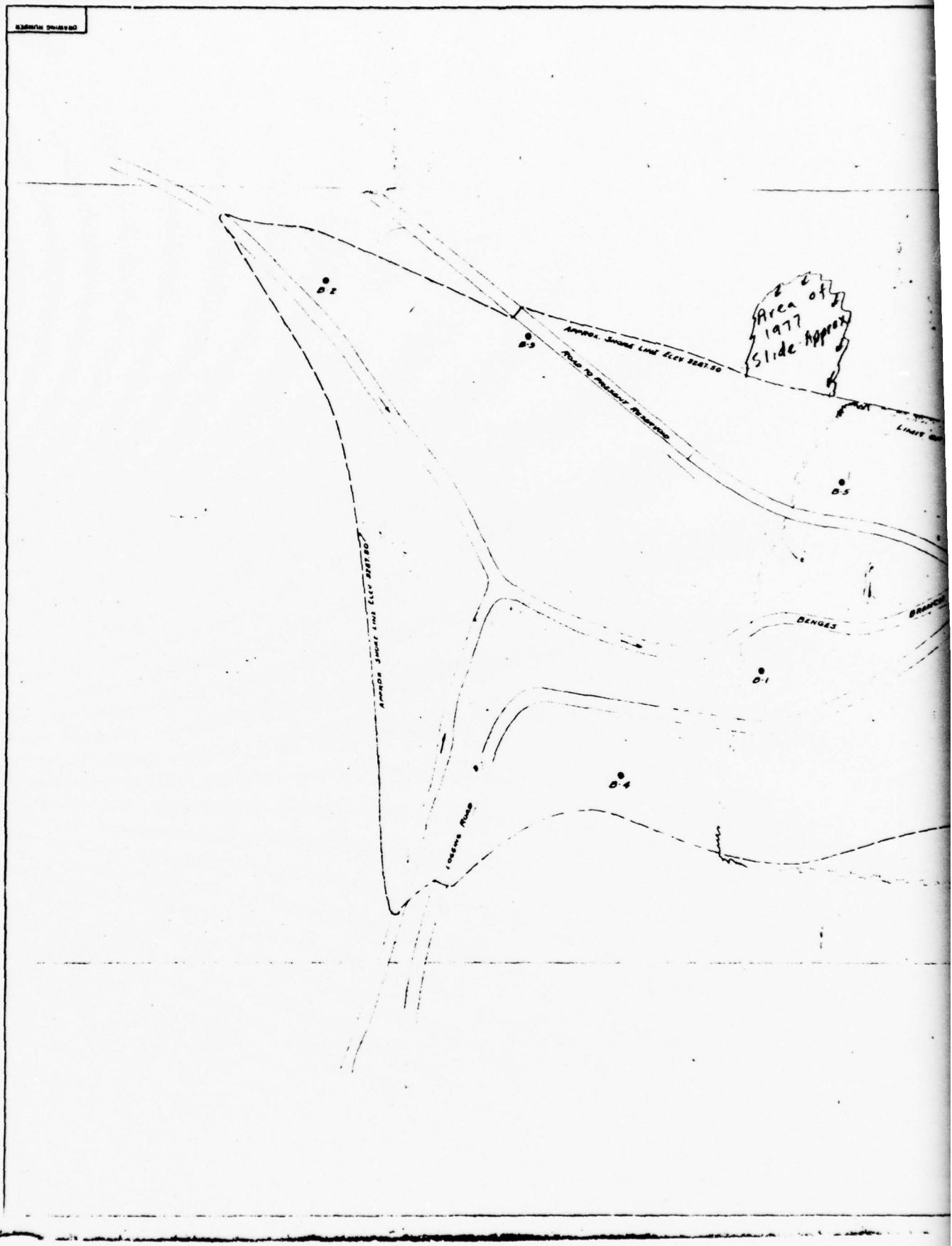
If a significant change is noted in any of the items of concern noted above, appropriate actions should be taken immediately.

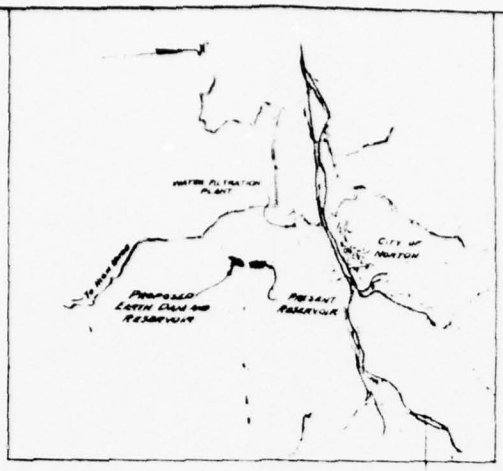
APPENDIX I

MAPS AND DRAWINGS

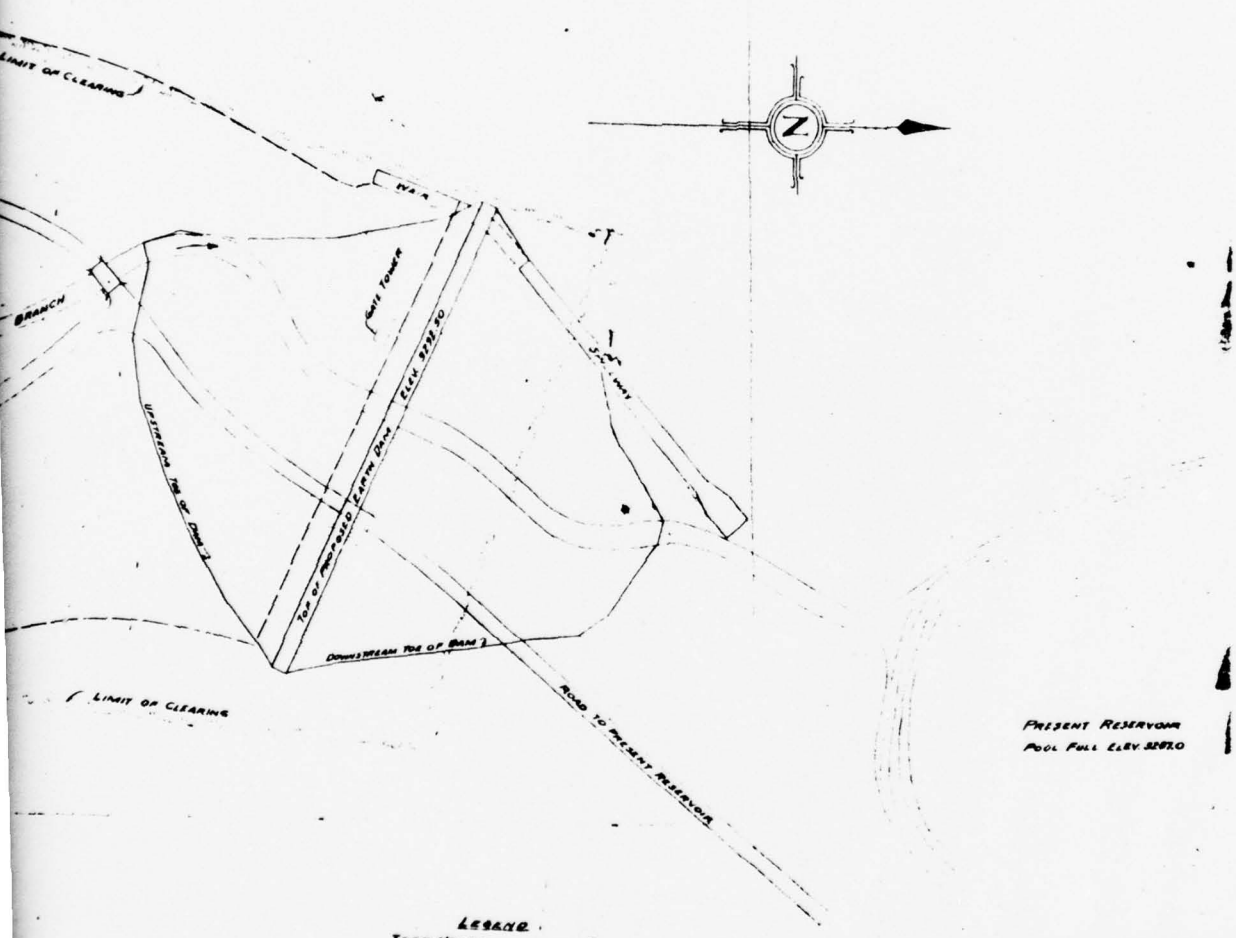


LOCATION MAP
APPENDIX I
FIGURE 1


DRAWING NUMBER
B-2
B-3
APPROX. SHORE LINE ELEV 2837.50
ROAD TO EMBANKMENT RESERVOIR
Area of 1977 Slide Approx
B-5
DENGES
B-1
B-4
LOBERG ROAD



VICINITY MAP
NORTON, VIRGINIA
SCALE: 1" = 1 MILE



LEGEND:
TEST HOLES - - - - - - ●

REVISIONS		
NO	DATE	DESCRIPTION

FIGURE 2
CITY OF NORTON, VIRGINIA
PROPOSED EARTH DAM & RESERVOIR
GENERAL LOCATION OF DAM & RESERVOIR

APPROVAL

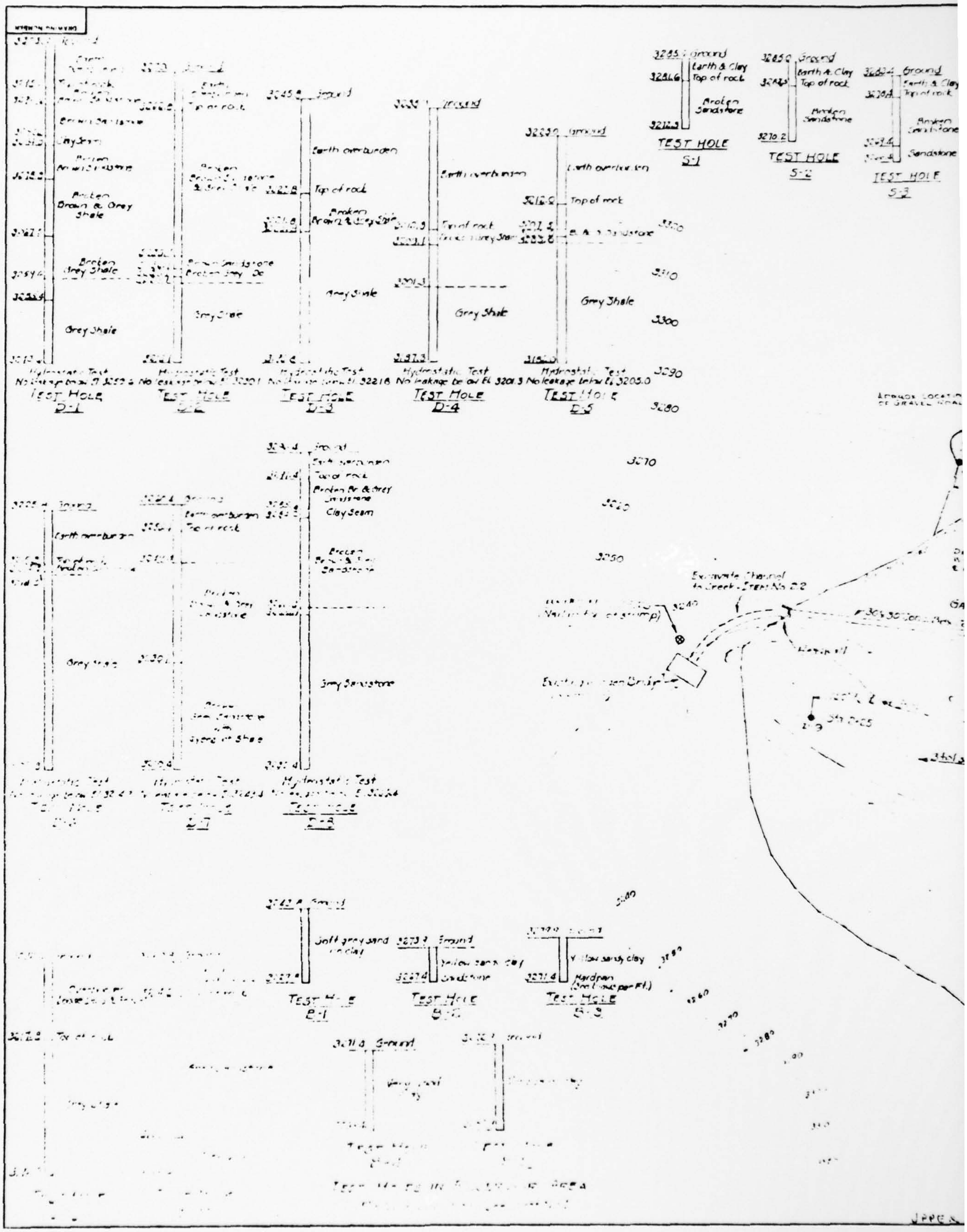
DRAWN BY C.W.T.
TRACED BY C.A.S.
SCALE 1"=50'-0"

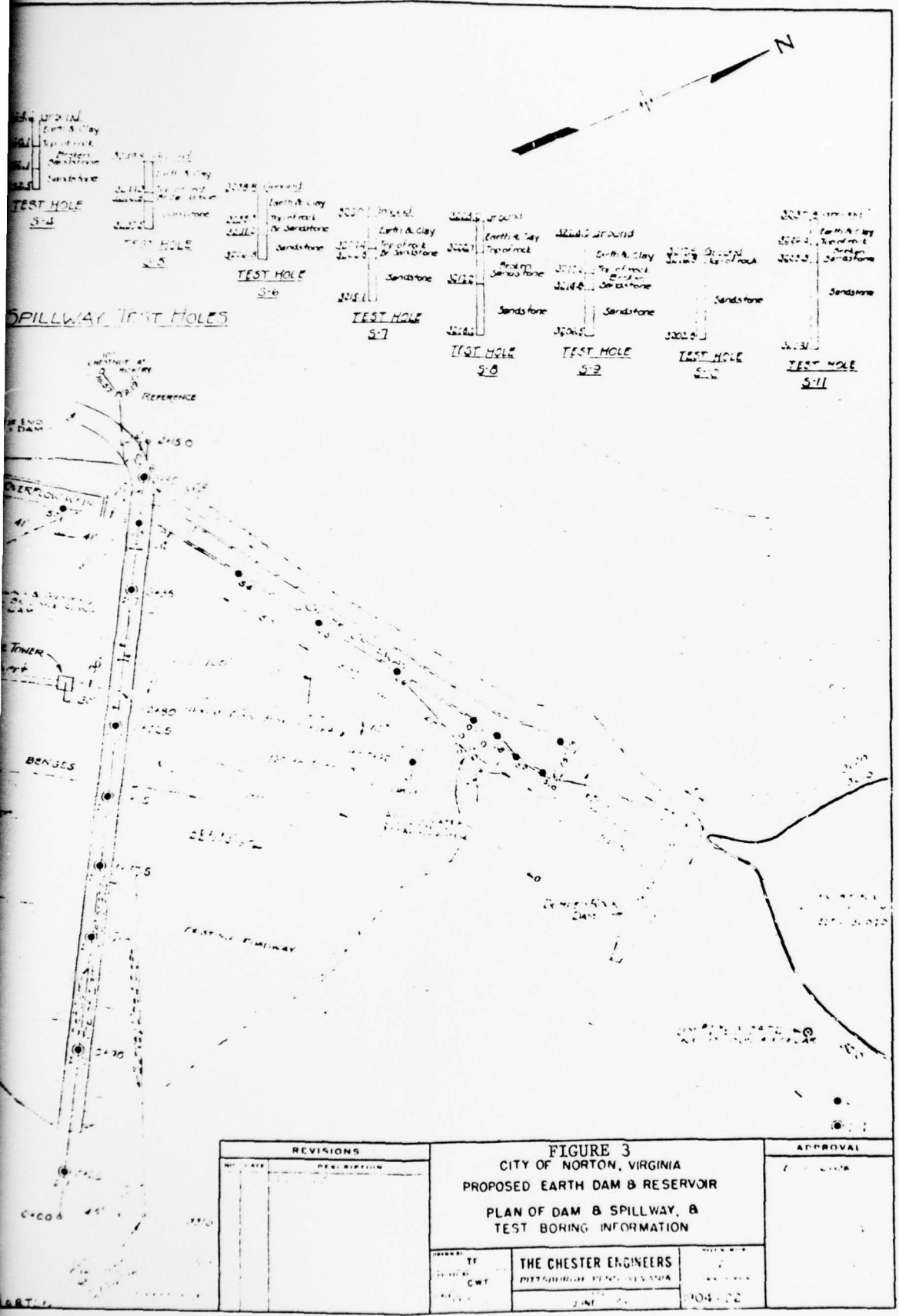
THE CHESTER ENGINEERS
PITTSBURGH, PENNSYLVANIA
JULY

SHEET NO. 1
1904-21

* UPPER NORTON

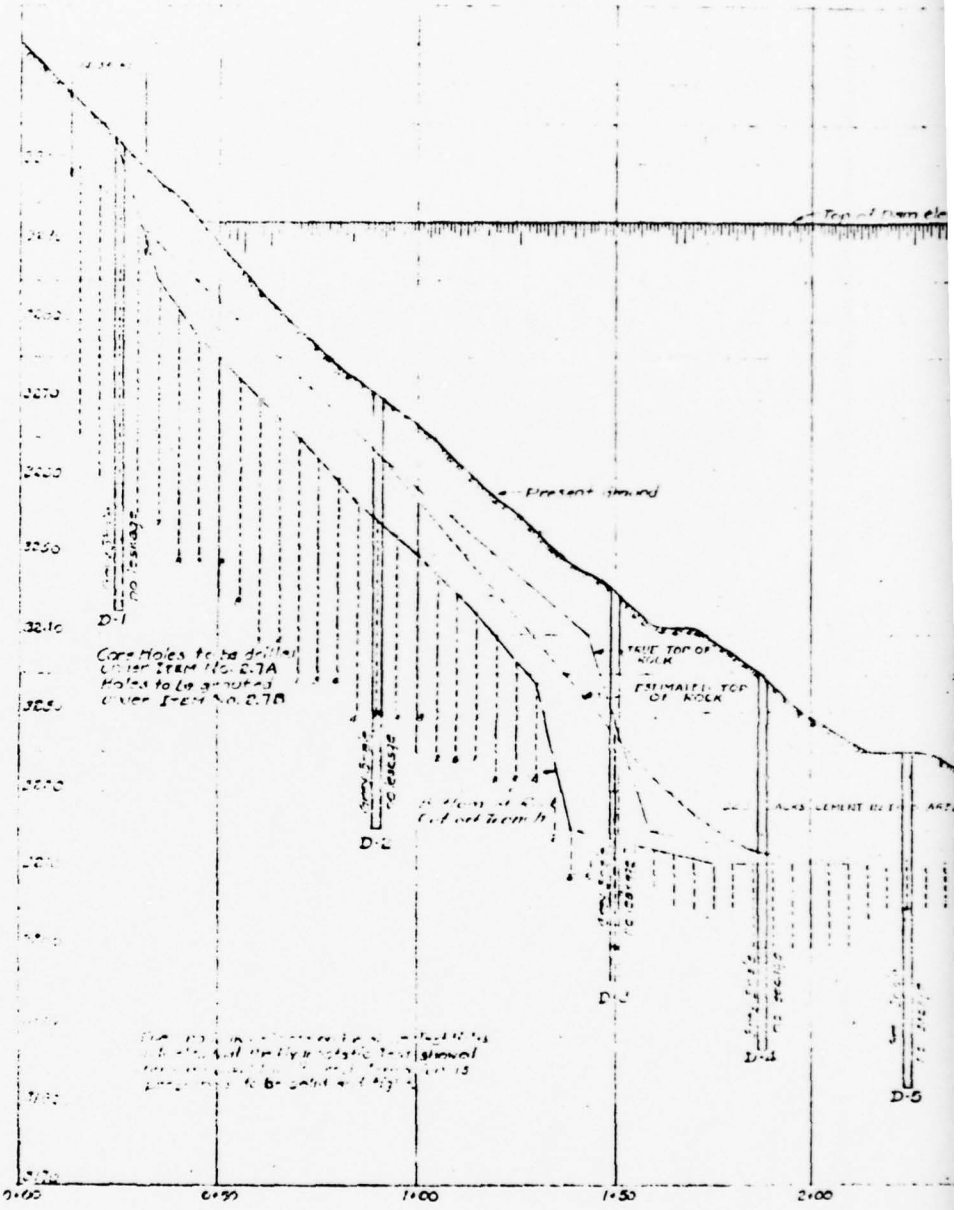
2

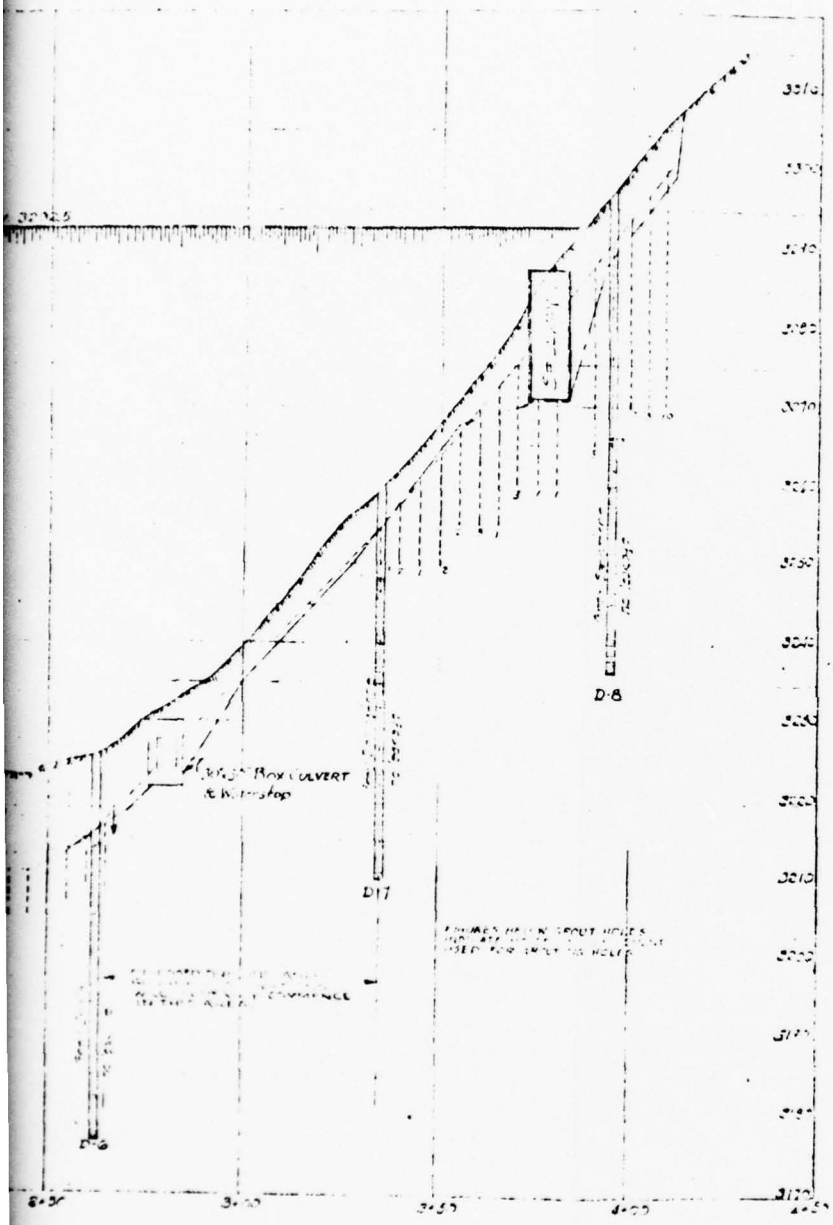

Grey Shale
Hydrostatic Test
No leakage below El. 3252.6
TEST HOLE
D-1
Grey Shale
TEST HOLE
D-2
3245.8 Ground
Earth overburden
Top of rock
Broken Brown & Grey Shale
Grey Shale
Hydrostatic Test
No leakage below El. 3221.8
TEST HOLE
D-3
Ground
Earth overburden
Top of rock
Grey Shale
3197.3
Hydrostatic Test
No leakage below El. 3201.3
TEST HOLE
D-4
3229.0 Ground
Earth overburden
3212.0 Top of rock
Grey Shale
Hydrostatic Test
No leakage below El. 3205.0
TEST HOLE
D-5
3285.1 Ground
Earth & Clay
3284.6 Top of rock
Broken Sandstone
3212.3
TEST HOLE
S-1
3285.0 Ground
Earth & Clay
Top of rock
Broken Sandstone
3270.2
TEST HOLE
S-2
Ground
Earth & Clay
Top of rock
Broken Sandstone
Sandstone
TEST HOLE
S-3
3320
3310
3300
3290
3280
3270
3260
3250
3240
Ground
Earth overburden
Top of rock
Broken Br. & Grey Sandstone
Clay Seam
Broken Brown & Grey Sandstone
Grey Sandstone
Hydrostatic Test
TEST HOLE
D-8
Earth overburden
Grey Shale
TEST HOLE
D-6
Earth overburden
Top of rock
TEST HOLE
D-7
Excavate Channel to Creek - Item No. 22
3242.8 Ground
Soft grey sand in clay
TEST HOLE
B-1
3273.9 Ground
Yellow sandy clay
3267.4 Sandstone
TEST HOLE
B-2
3279.8 Ground
Yellow sandy clay
3271.4 Hardpan
TEST HOLE
B-3
Ground
Ground



REVISIONS	FIGURE 3 CITY OF NORTON, VIRGINIA PROPOSED EARTH DAM & RESERVOIR PLAN OF DAM & SPILLWAY, & TEST BORING INFORMATION	APPROVAL
NO. DATE DESCRIPTION	THE CHESTER ENGINEERS PITTSBURGH, PENNSYLVANIA	

2


D-1
D-2
D-3
D-4
D-5
TRUE TOP OF ROCK
ESTIMATED TOP OF ROCK
0+00
0+50
1+00
1+50
2+00



REVISIONS		
NO.	DATE	DESCRIPTION

FIGURE 4
CITY OF NORTON, VIRGINIA
PROPOSED EARTH DAM & RESERVOIR

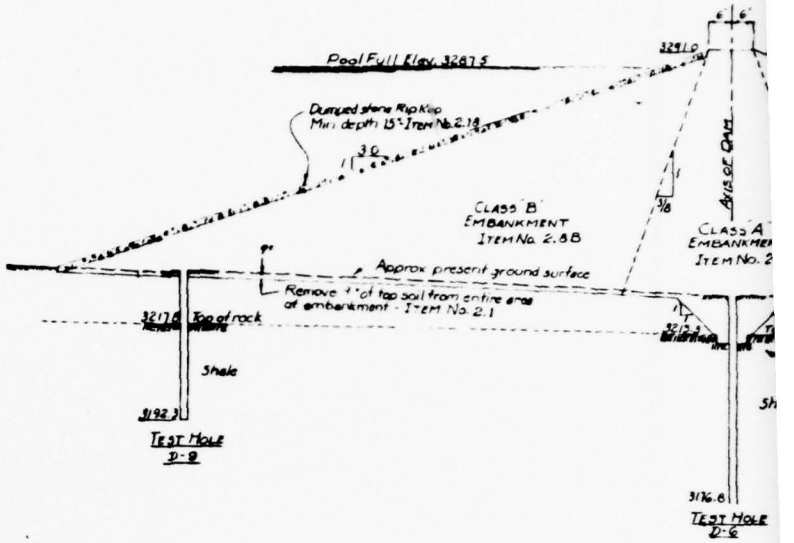
SECTION ACROSS VALLEY

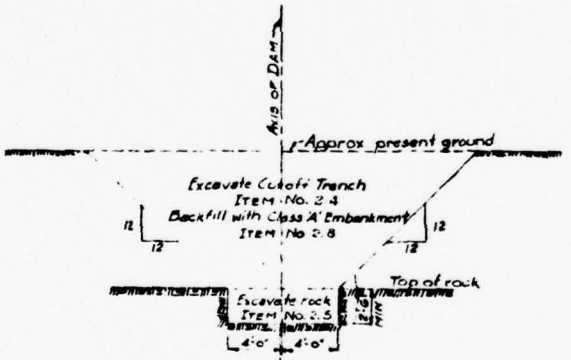
APPROVAL

C. F. Sect.

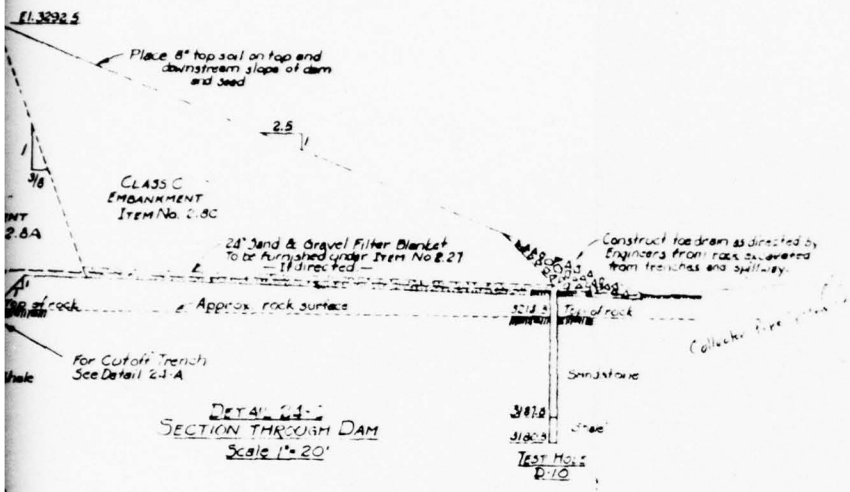
DRAWN: CWT	THE CHESTER ENGINEERS	SHEET NO. 3
CHECKED: RS	PITTSBURGH, PENNSYLVANIA	
SCALE: HOR. 1"=50' VERT. 1"=10'	DESIGNED:	1904-23

UPPER NORTON



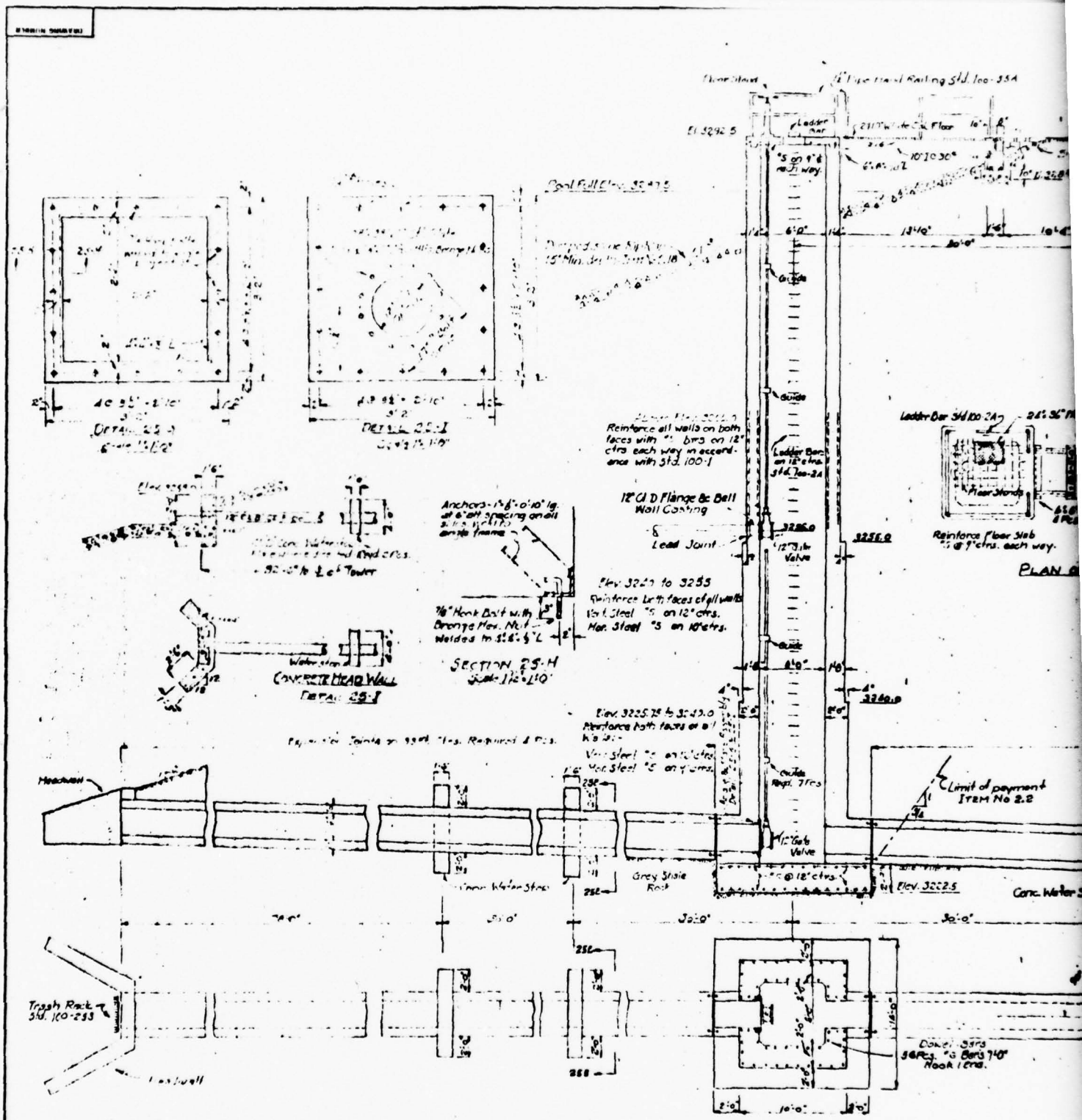


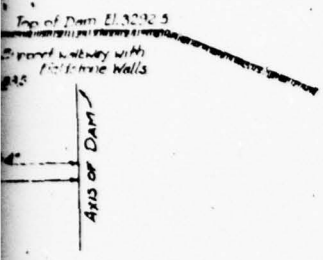
CUTOFF TRENCH
DETAIL 24-A
Scale 3/16"=1'0"

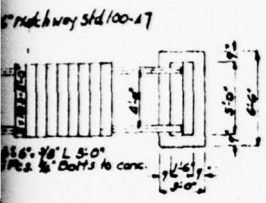


DETAIL 24-1
SECTION THROUGH DAM
Scale 1" = 20'

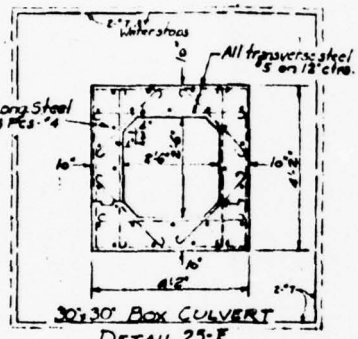
REVISIONS			FIGURE 5	APPROVAL
NO.	DATE	DESCRIPTION	CITY OF NORTON, VIRGINIA PROPOSED EARTH DAM & RESERVOIR SECTION THROUGH DAM	
			DRAWN BY C.W.T. / CHECKED BY C.H.S. / SCALE AS NOTED THE CHESTER ENGINEERS PITTSBURGH PENNSYLVANIA DATE JUNE 1956 SHEET NUMBER 4 DRAWING NUMBER 19.04-24	


Floor Stand
Ladder Bar
El. 3292.5
Reinforce all walls on both faces with "5" bars on 12" ctrs each way in accordance with Std. 100-1
12" Cl D Flange & Bell Wall Casting
Lead Joint
12" Gate Valve
Ladder Bar Std 100-2A
Floor Stands
Reinforce Floor Slab "5" @ 9" ctrs. each way.
PLAN
Anchors - 1" ϕ - 0'-10" lg. at 6'-0" spacing on all sides of frame
⅞" Hook Bolt with Bronze Hex. Nut welded to 3"ϕ - ½" L
SECTION 25-H
Elev. 3249 to 3255
Reinforce both faces of all walls Vert. Steel "5" on 12" ctrs. Hor. Steel "5" on 10" ctrs.
Concrete Head Wall
Detail 25-I
Elev. 3225.75 to 3249.0
Reinforce both faces of all walls
Vert. Steel "5" on 12" ctrs
Hor. Steel "5" on 9" ctrs.
Limit of payment ITEM No 2.2
Headwall
Grey Shale Rock
Elev. 3222.5
Trash Rack Std. 100-253
Handwall
Detail 25-A
30" x 30" Box Culvert & Gate Tower
Scale 3/8"-1'0"

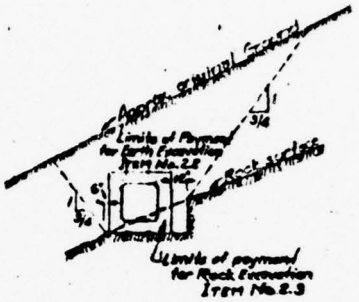




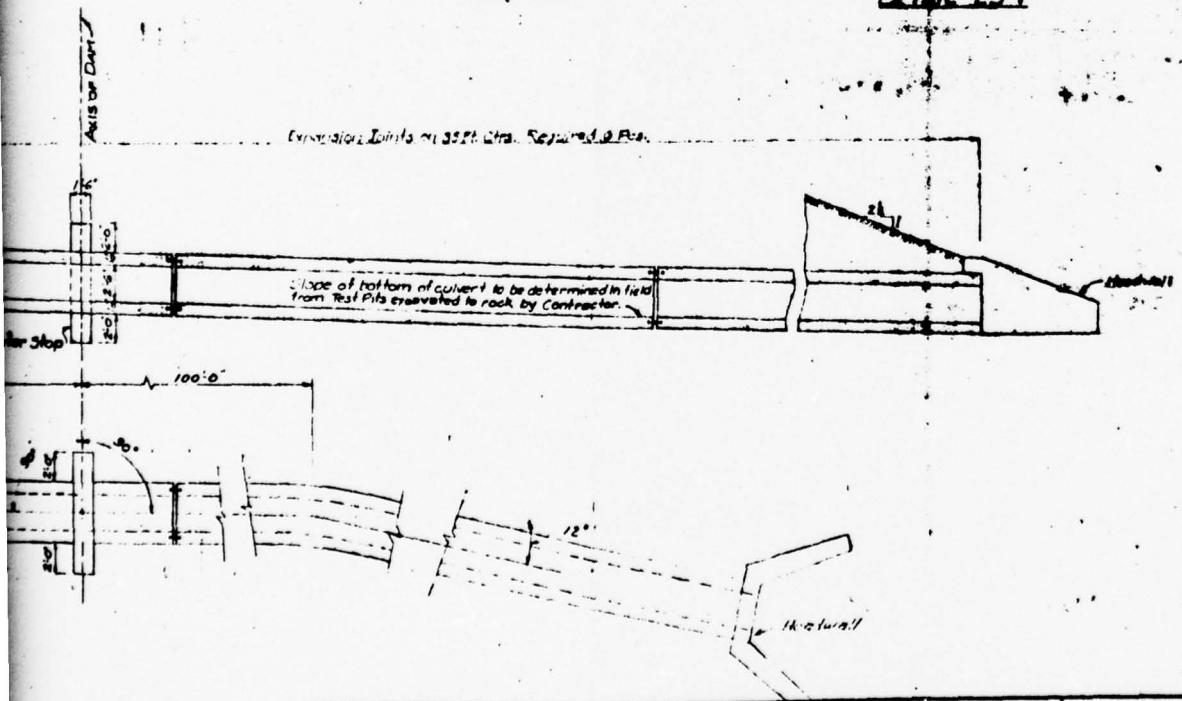
Gate Tower & Bridge
Scale 3/16"=1'-0"
Detail 25-D



30'x30' Box Culvert
Detail 25-E
Scale 1/2"=1'-0"



Limits of Excavation Payments
For Box Culvert & Gate Tower
Detail 25-F



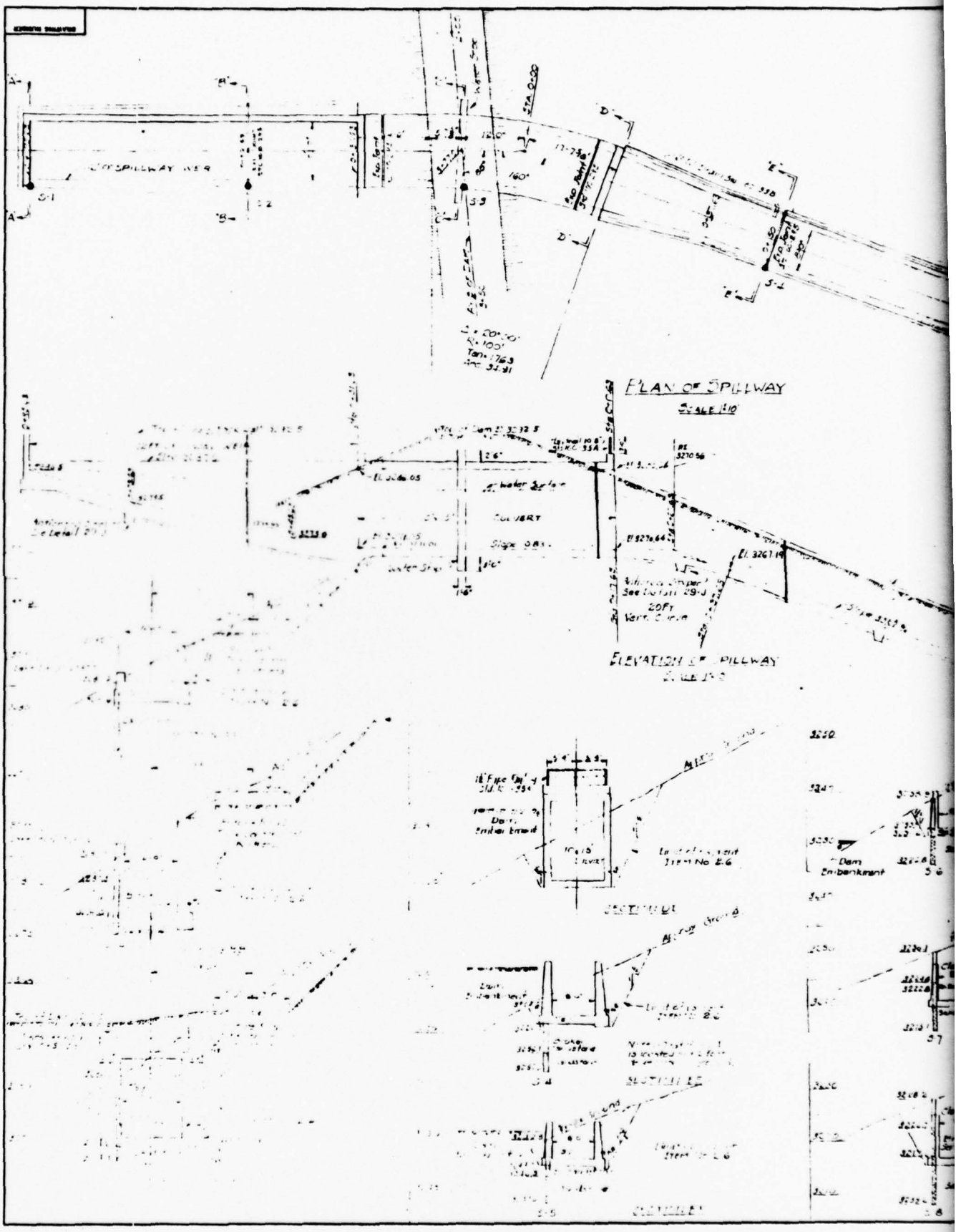
REVISIONS		
NO.	DATE	DESCRIPTION
1	11-57	AS BUILT

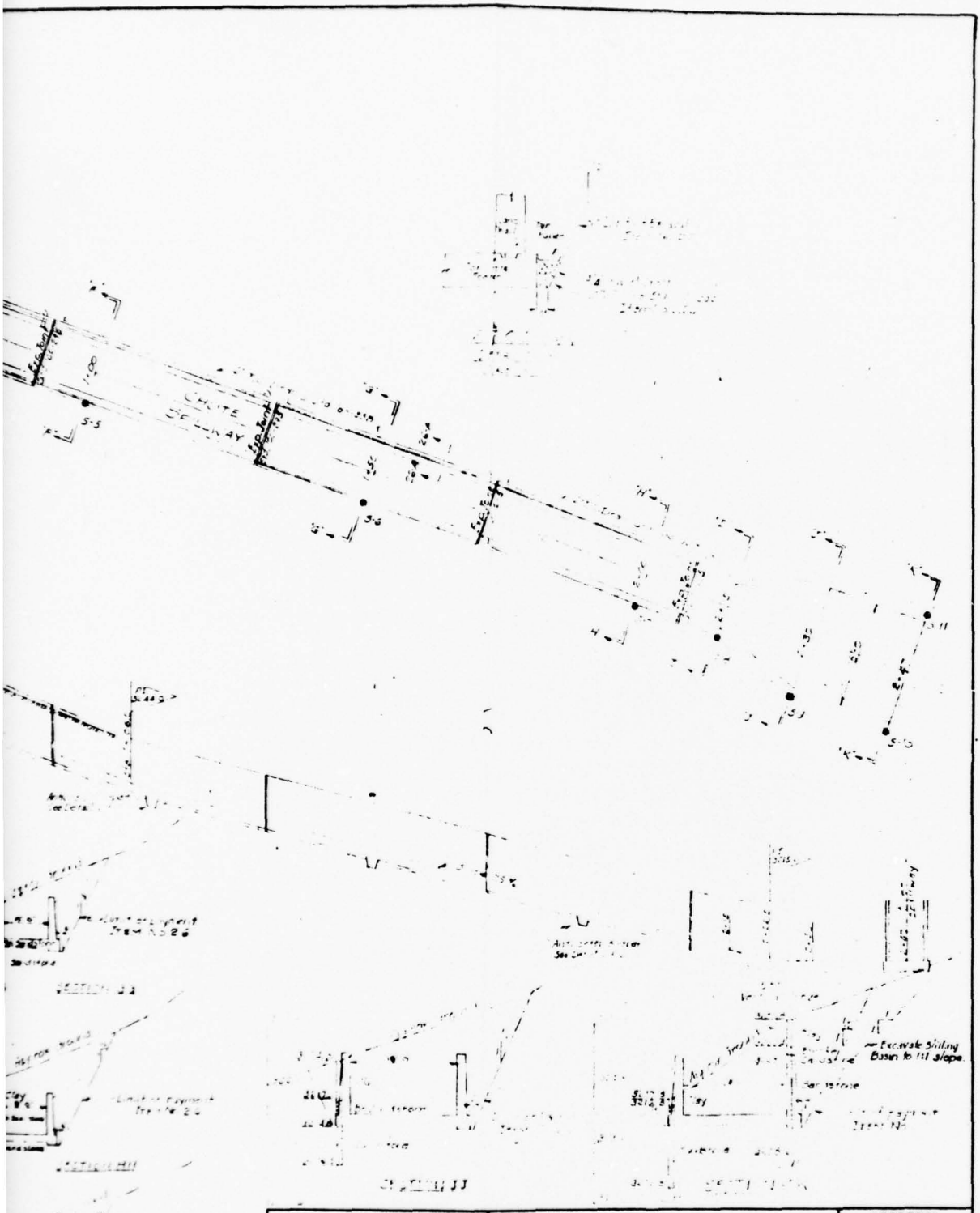
FIGURE 6
CITY OF NORTON, VIRGINIA
PROPOSED EARTH DAM & RESERVOIR
BOX CULVERT & GATE TOWER

DESIGN BY C.W.T.	THE CHESTER ENGINEERS	SHEET NUMBER 5
COMPUTED BY C.R.S.	PITTSBURGH, PENNSYLVANIA	DRAWING NUMBER 1904-25
SCALE AS NOTED	DATE JUNE, 1956	

APPROVAL

Upper Norton


PLAN OF SPILLWAY
SCALE 1:10
ELEVATION OF SPILLWAY
SCALE 1:10
CULVERT
Dam Embankment
SECTION E-E
SECTION F-F
SECTION G-G



REVISIONS		
NO.	DATE	DESCRIPTION
		GENERAL RD. SIGNS

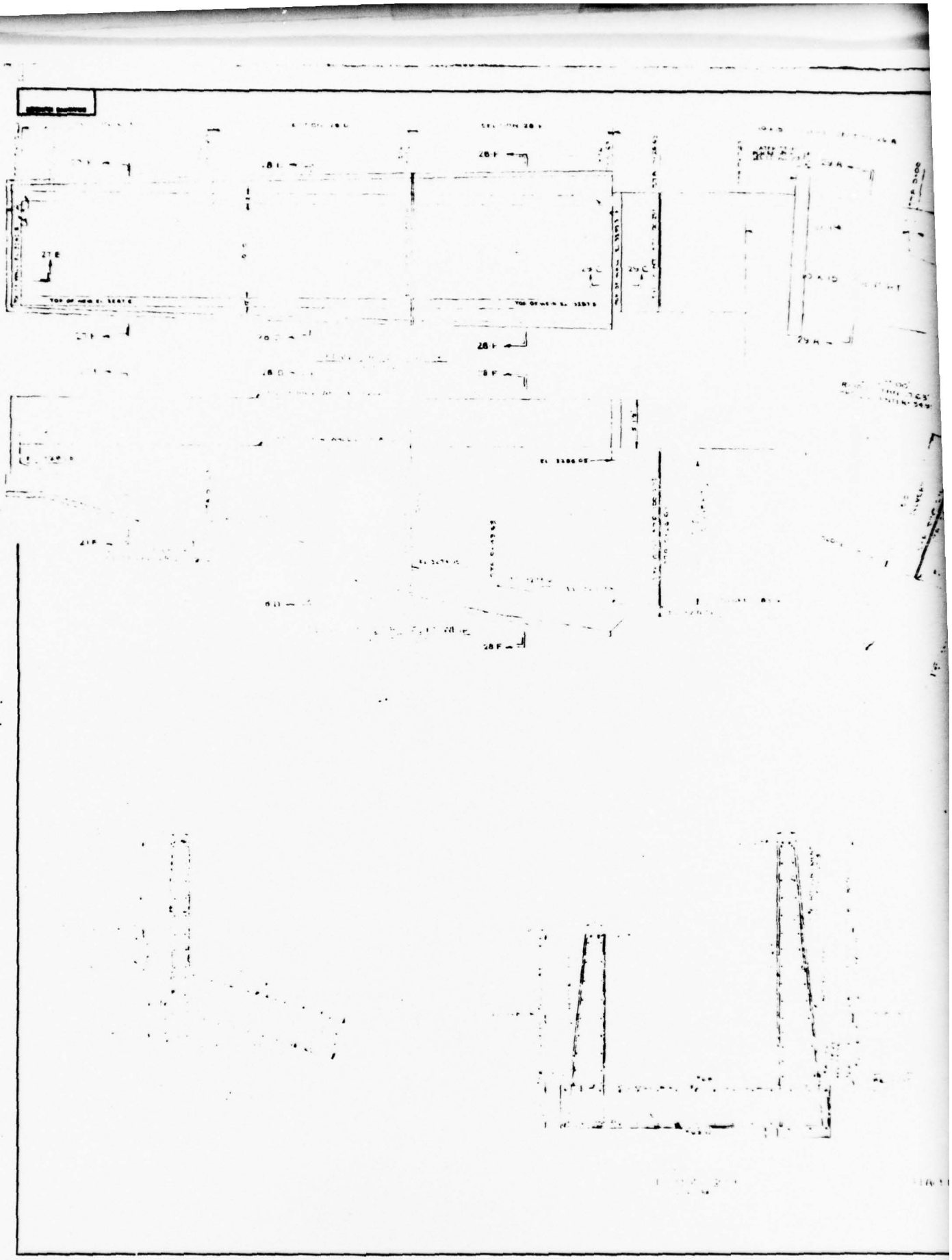
FIGURE 7
CITY OF NORTON, VIRGINIA
PROPOSED EARTH DAM & RESERVOIR

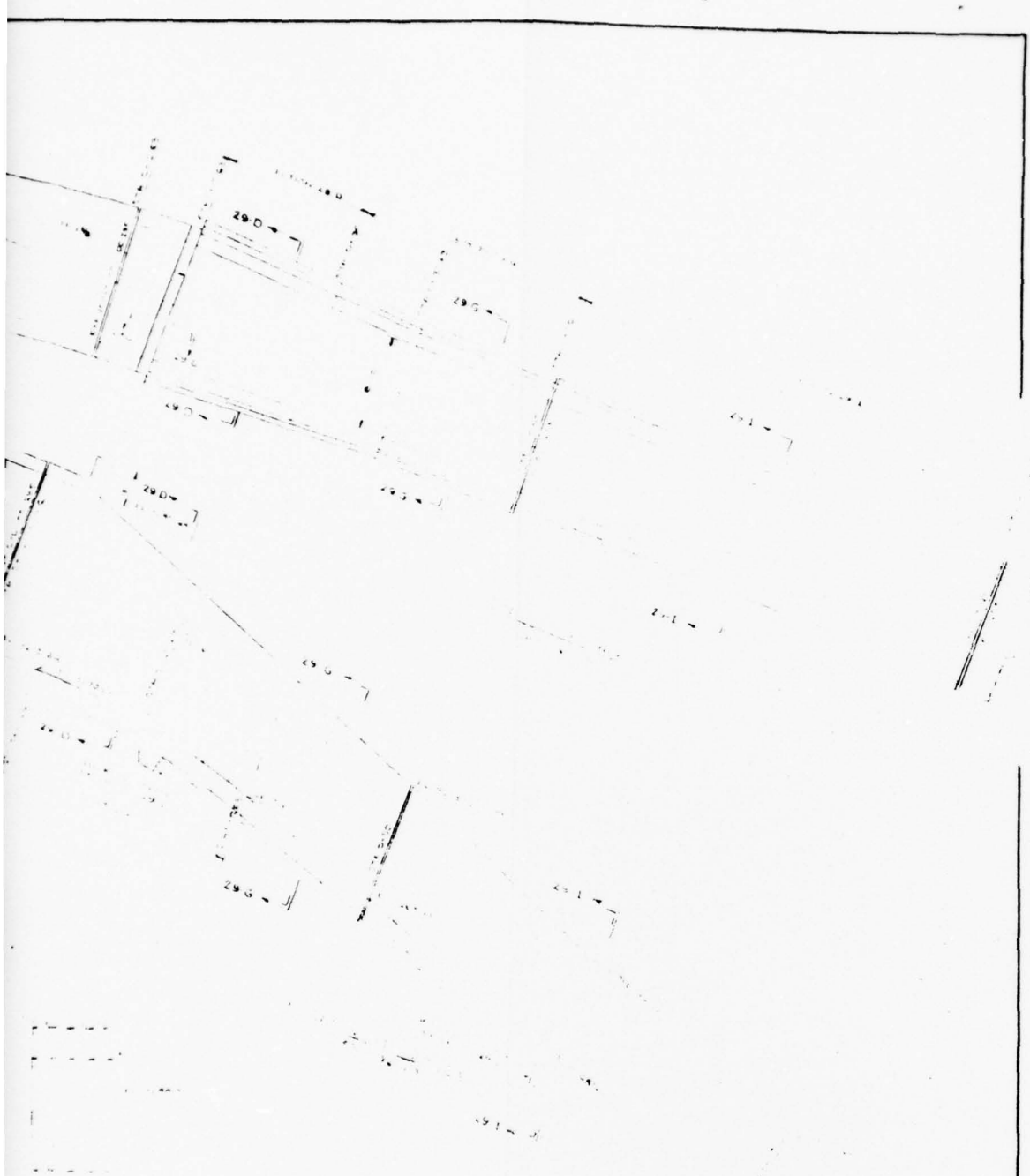
OVERFLOW WEIR & SPILLWAY

DRAWN BY C.W.T.	THE CHESTER ENGINEERS	SHEET NUMBER 6
CHECKED BY C.K.S.	PITTSBURGH, PENNSYLVANIA	DRAWING NUMBER 1904-26
SCALE 1" = 10'	DATE JUNE 1956	

APPROVAL

C. K. Steel





REVISIONS		
NO	DATE	DESCRIPTION
1	6/27/74	GENERAL REVISIONS

FIGURE 8
CITY OF NORTON, VIRGINIA
PROPOSED EARTH DAM & RESERVOIR
STRUCTURAL DETAILS OF OVERFLOW WEIR & SPILLWAY

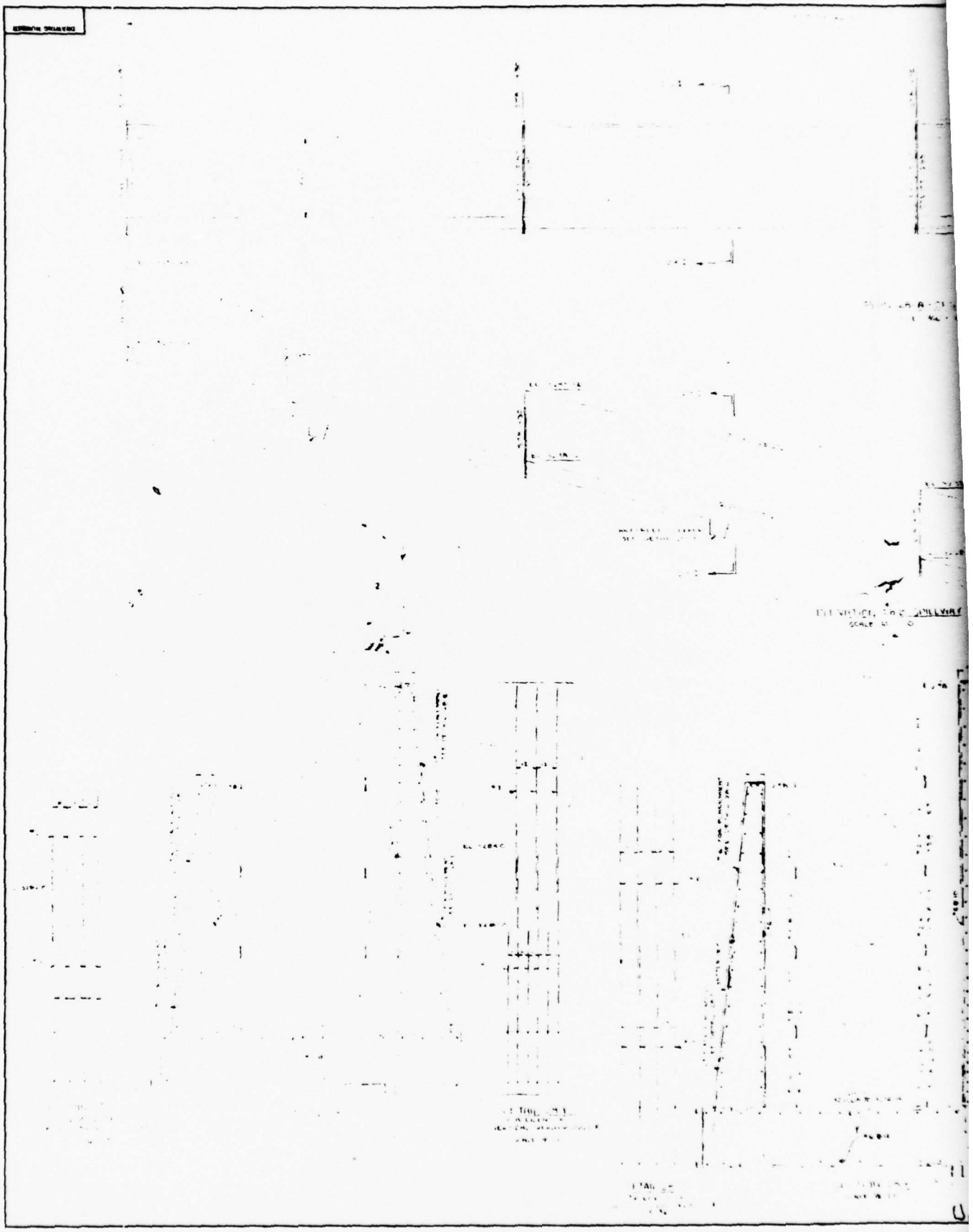
DRAWN BY W.D.R.	THE CHESTER ENGINEERS	SHEET NUMBER 7
CHECKED BY G.K.S.	PITTSBURGH PENNSYLVANIA	DRAWING NUMBER 1904-27
SCALE AS NOTED	DATE JUNE 1976	

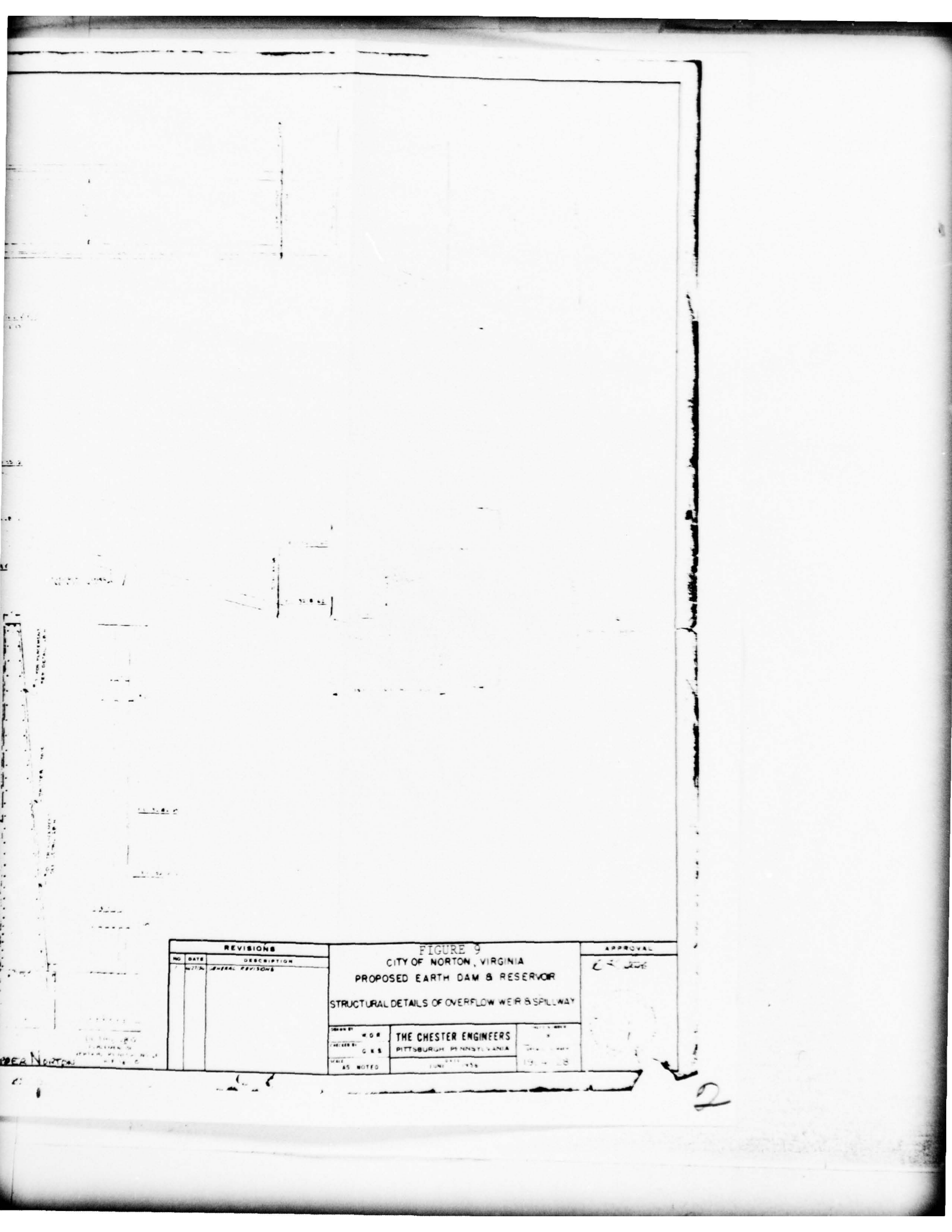
APPROVAL

L. F. Stark

UPPER NUATSN

2





REVISIONS		
NO	DATE	DESCRIPTION
1	11-71	GENERAL REVISIONS

FIGURE 9

CITY OF NORTON, VIRGINIA

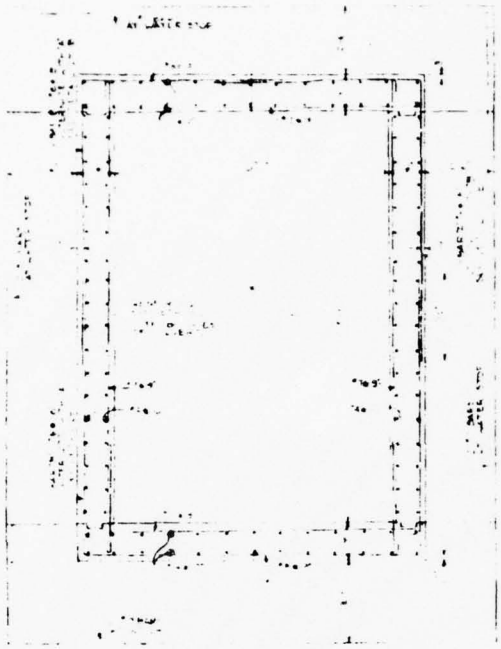
PROPOSED EARTH DAM & RESERVOIR

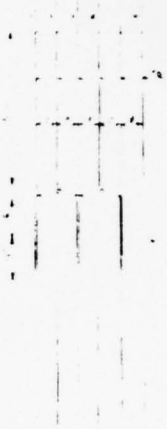
STRUCTURAL DETAILS OF OVERFLOW WEIR & SPILLWAY

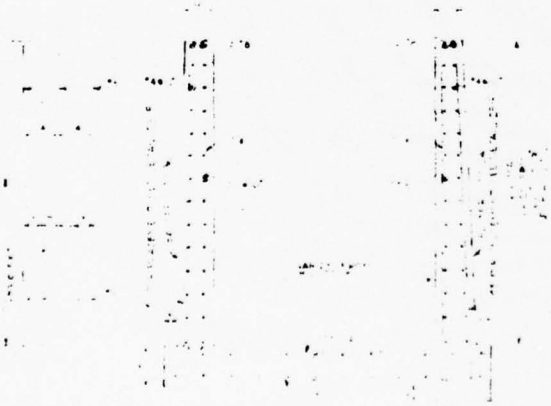
DRAWN BY W.G.R.	THE CHESTER ENGINEERS	SHEET NO. 4
CHECKED BY G.R.S.	PITTSBURGH, PENNSYLVANIA	DATE 1971
SCALE AS NOTED	JOB NO. 1556	19-71-28

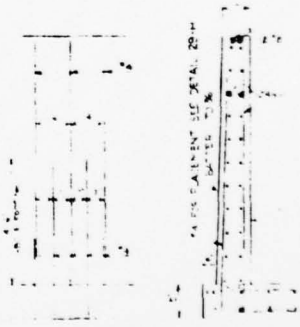
APPROVAL

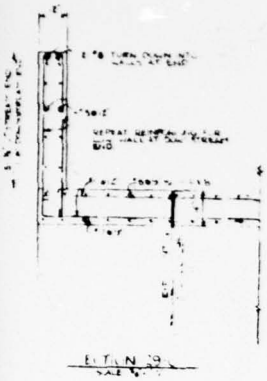
2

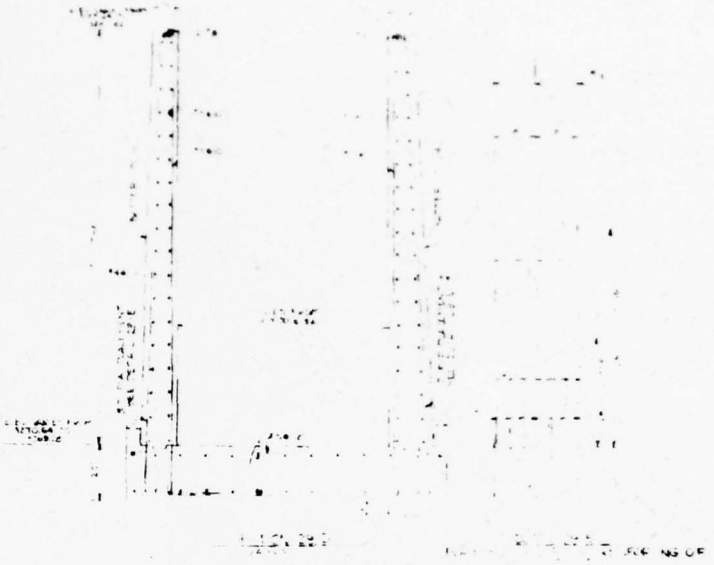


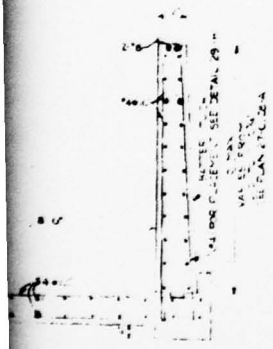












REVISIONS		
NO	DATE	DESCRIPTION
1	11/15/56	GENERAL REVISIONS

FIGURE 10

CITY OF NORTON, VIRGINIA

PROPOSED EARTH DAM & RESERVOIR

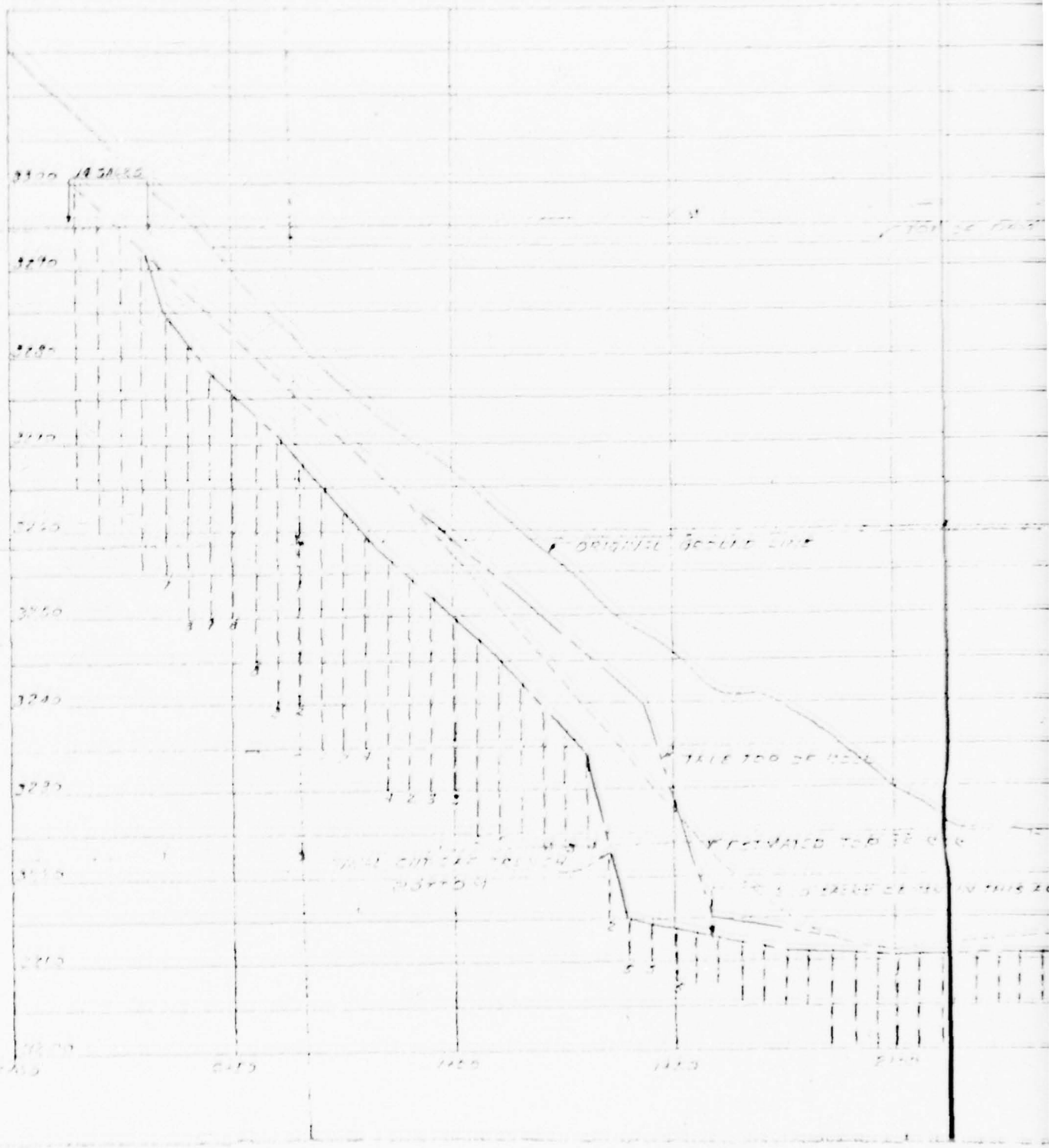
STRUCTURAL DETAILS OF OVERFLOW WEIR & SPILLWAY

DRAWN BY V.K.L.	THE CHESTER ENGINEERS	SHEET NUMBER 9
CHECKED BY C.R.S.	PITTSBURGH, PENNSYLVANIA	DRAWING NUMBER 1904-29
SCALE AS NOTED	DATE JUNE 1956	

APPROVAL

Upper Norton

2


ORIGINAL GROUND LINE

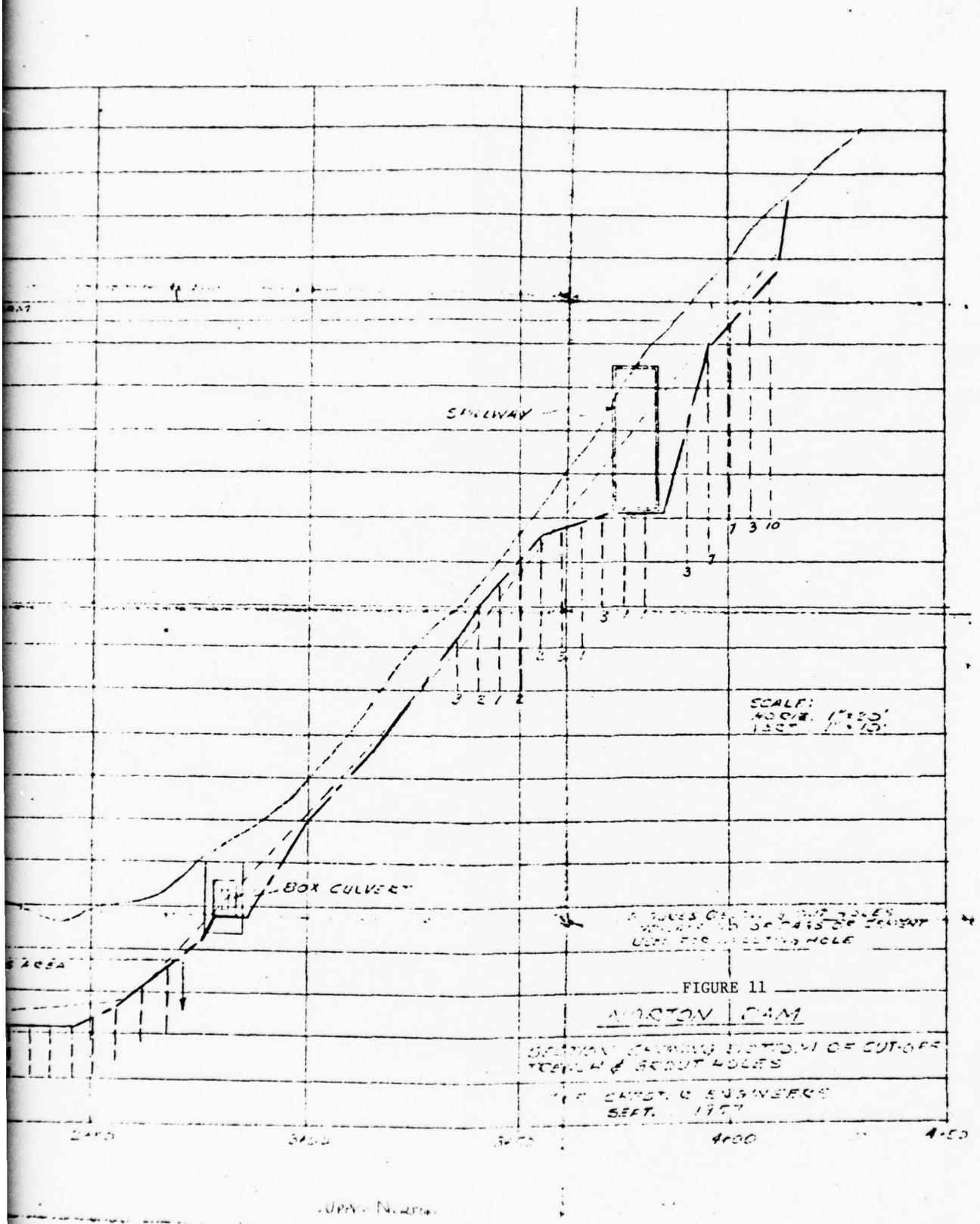


FIGURE 11

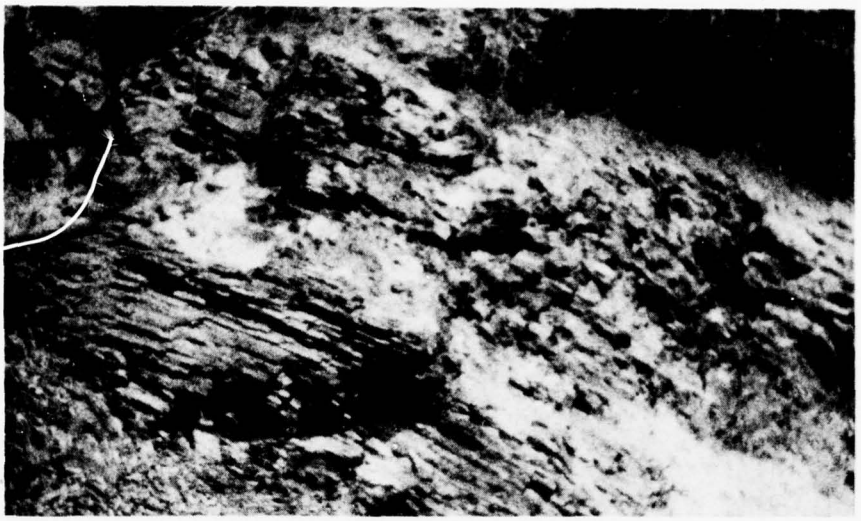
ANSTON DAM

SECTION THROUGH BOTTOM OF CUT-OFF TRENCH & ABOUT LOCKS

U.S. CORPS OF ENGINEERS
SEPT. 1957

APPENDIX II

PHOTOGRAPHS



June 1978

CLOSE-UP AT TOP OF SLIDE. NOTE: EXPOSED LAYERS OF WEATHERED SOFT SHALE

June 1978

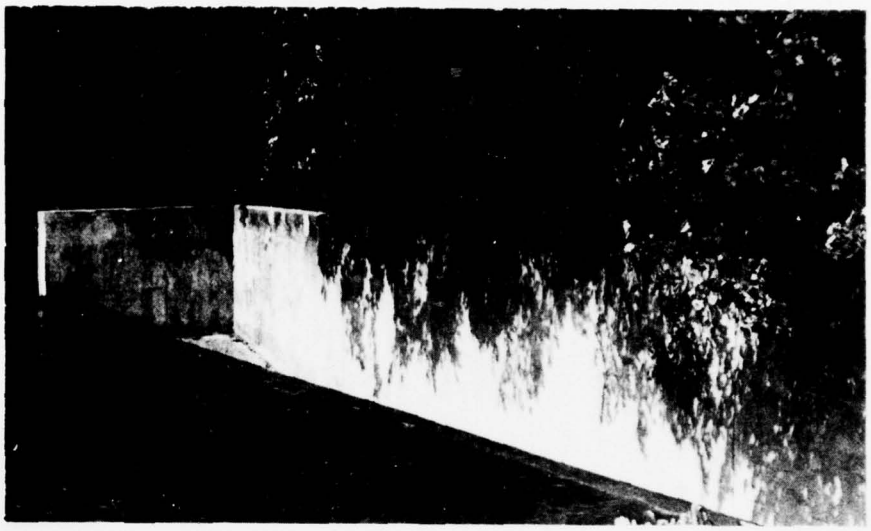
VIEW OF TOP AREA OF SLIDE

June 1978

GROUTED RIPRAP ON UPSTREAM FACE OF LEFT ABUTMENT

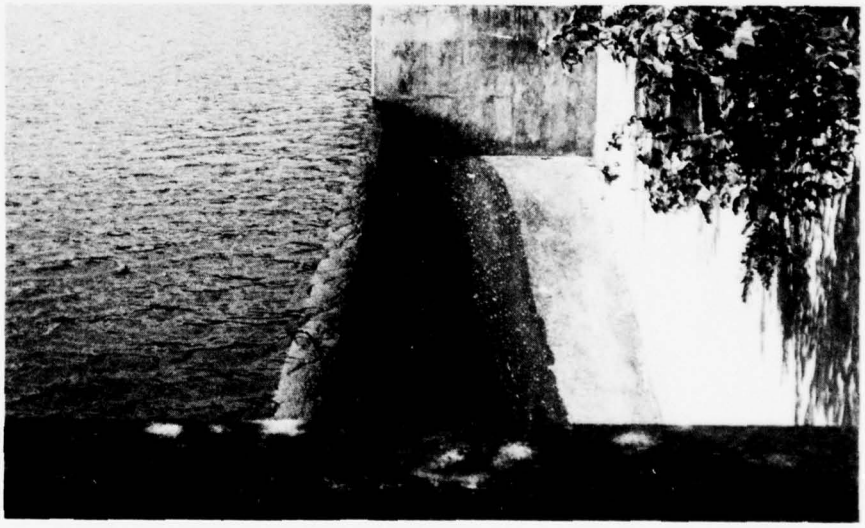
June 1978

SPILLWAY OUTLET - LOOKING UPSTREAM



June 1978

OVERFLOW WEIR - NOTE GROWTH OF TREES



June 1978

OVERFLOW WEIR - NOTE WATER FLOWING OVER THE WEIR

June 1978

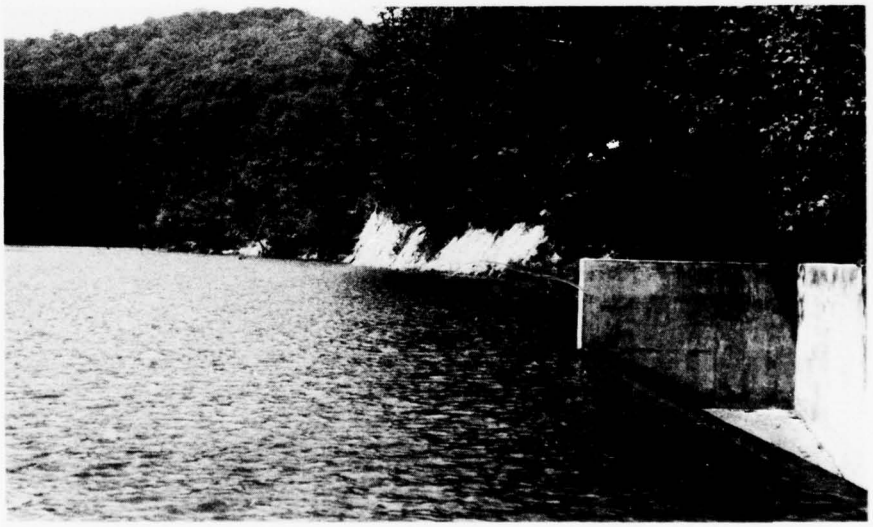
RESERVOIR SHORE LINE SLOPE FAILURE

June 1978

SLOPE FAILURE AREA NEAR BOATING DECK -
NOTE EXPOSED MATERIAL

June 1978

RESERVOIR SHORELINE SLOPE FAILURE - NOTE BENT TREES



June 1978

EXPOSED SLOPES AND OVERFLOW WEIR,
NOTE SLOPE FAILURE AREA IN BACKGROUND

NOTE LEAKAGE FROM SPILLWAY AREA

June 1978

June 1978

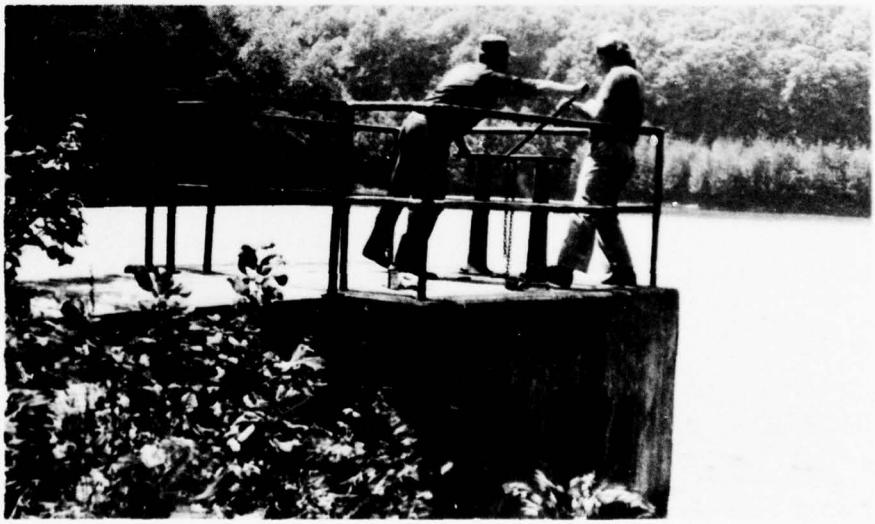
NOTE LEAKAGE FROM SPILLWAY BASE

June 1978

LOOKING DOWNSTREAM IN THE SPILLWAY CHUTE -
NOTE DISPLACEMENT OF JOINT

June 1978

TOP OF DAM LOOKING TOWARD RIGHT ABUTMENT.
NOTE: TREES GROWTH ON BOTH UP AND DOWNSTREAM FACES OF DAM



June 1978

OPERATORS FOR THE VALVES - NOTE RIGHT
SIDE VALVE BEING OPERATED

APPENDIX III

FIELD OBSERVATIONS

Check List
Visual Inspection
Phase 1

Name Dam: Upper Norton County: Wise State: Virginia Coordinators: Norfolk District Corps of Engineers

Date(s) Inspection: 12 June, 1978 Weather: Clear Temperature: 82°F

Pool Elevation at Time of Inspection: 3287.6 feet m.s.l. Tailwater at Time of Inspection: 3215 feet m.s.l. ±

Gilbert Associates, Inc.

Inspection Personnel:

James A. Hagen

Yogesh S. Shah

Nazir A. Qureshi

Also Present:

Joe Baker - City of Norton, Manager

Earl Brown - City of Norton

Ralf Gilly - City of Norton

Buck Arnold - Virginia State Water Control Board

James A. Hagen - Recorder

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None were observed	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Minor erosion near toe.	Should be observed periodically for increased erosion.
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	Alignment is good, but there were numerous trees on the upstream and downstream slopes. Some were 30-40 feet high and eight inches or more in diameter.	Trees should be removed from the dam and abutments and a stable ground cover established.
RIPRAP FAILURES	Riprap generally intact. Minor dislocations.	No action required at this time.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Generally satisfactory. Small seepage at junction of spillway and dam embankment.	The source of seepage should be determined.
ANY NOTICEABLE SEEPAGE	See above	
STAFF GAGE AND RECORDER	None	
DRAINS	None visible in embankment.	

OUTLET WORKS

Sheet 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Conduit not visible.	None
INTAKE STRUCTURE	Three leaks, about 1/4 inch in diamter were noticed about 15 feet below the top of the gate tower.	The leaks could be from concrete tie holes and did not appear serious.
OUTLET STRUCTURE	There was surface spalling at the 30 inch box culvert outlet as indicated on the photos.	None
OUTLET CHANNEL	There are trees, brush, and scattered boulders in the immediate channel.	No action required. The design provides for a small stilling pool below the discharge.
EMERGENCY GATE	None.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	In good condition	
APPROACH CHANNEL	Not visible.	
DISCHARGE CHANNEL	Minor joint displacement and joint material extrusion at station 0 + 50 on right wall of chute spillway. Wall drains were not flowing into channel at time of inspection.	At this time, these conditions do not appear to be significant enough to cause a hazardous condition.
BRIDGE AND PIERS	The concrete bridge over the spillway appears to be in good condition.	

GATED SPILLWAY
(Spillway is Ungated)

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	Not applicable.	
APPROACH CHANNEL	Not applicable.	
DISCHARGE CHANNEL	Not applicable.	
BRIDGE AND PIERS	Not applicable.	
GATES AND OPERATION EQUIPMENT	Not applicable.	

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATION
MONUMENTATION/SURVEYS	Several were shown on the drawings.	
OBSERVATION WELLS	None	
WEIRS	None	
PIEZOMETERS	None	
OTHER	None	

RESERVOIR

Sheet 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	There was a slope failure during the Spring of 1977 on the west shoreline. Exposed areas elsewhere on the same side show indications of shoreline erosion and other small slope failures.	The slopes need further examination to evaluate their stability during an earthquake or over the life of the reservoir.
SEDIMENTATION	Except at the slide areas, there was no visual evidence of excessive sedimentation. However, the lower level inlet is not operable and may be clogged with sediment.	None.

DOWNSTREAM CHANNEL

Sheet 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	There are some trees and many boulders in the channel. The drawings indicate the boulders are to form a stilling basin. Below that the channel widens into Lower Norton Reservoir.	None
SLOPES	The slopes along the sides of the downstream channel are flatter than those in the reservoir area.	None
APPROXIMATE NO. OF HOMES AND POPULATION	There are no homes between the dam and Lower Norton Reservoir. In a narrow channel extending about two miles downstream, below the lower dam, there are approximately 50 houses. Most of these have been vacated in anticipation of a major highway under construction to provide a southerly bypass for the City of Norton. Beyond that there are approximately 100 buildings and homes in the flow path before the Benges Branch joins the Powell River nearly three miles below the dam. There are about 500 people living downstream who could be seriously affected by flood waters resulting from a failure of this dam.	

APPENDIX IV

GEOLOGY REPORTS

(NOT AVAILABLE)

APPENDIX V

STABILITY CALCULATIONS

(NOT AVAILABLE)

APPENDIX VI

MISCELLANEOUS INFORMATION

APPENDIX VI-A
CONSTRUCTION EARTHWORK SPECIFICATIONS

Any replacement of materials shall be made in accordance with these specifications and without cost to the Owner. The Contractor shall at all times maintain the embankment in a manner satisfactory to the Engineers until final completion of all work under the contract. The Contractor may be required to cease work at any time when, in the opinion of the Engineers, satisfactory work cannot be done because embankment materials are frozen or too wet, and to suspend work until satisfactory conditions are obtained.

Quantities, Lines and Grades

(G-2.8-6) Embankments shall be constructed to the levels, lines, grades, and cross-sections indicated on the drawings, or as established by the Engineers in the field. The total quantities of embankment material are calculated from the embankment lines shown on the drawings and are approximately final quantities, but are not guaranteed as such. The Contractor shall make his own quantity survey from the data given to ascertain the quantities to his own satisfaction.

Fill Classifications

(G-2.8-7) Three types of construction shall be utilized in making the embankment designated as Class "A", Class "B" and Class "C" embankment. Class "A" embankment shall be material which shall be composed of at least 50% clay and the remainder soft shale. Most of the clay material will probably have to be excavated from the borrow area. Class "B" embankment shall be composed of material which is not less than 30% clay and the balance shale. Class "C" embankment shall be composed of any material not suitable for Class "A" or Class "B" embankment, which will compact sufficiently so as to produce no unequal settlement between it and the adjacent class of embankment. The Contractor shall be careful in spreading the fill material to obtain proper mixture of materials so as to conform to the specifications for the type of embankment specified. Layers of shale and clay shall not be segregated. If shale deposited is in large pieces, it shall be broken up by suitable machinery and thoroughly mixed with proper amount of clay before compaction.

Selection of Material

(G-2.8-8) The selection of materials which will be designated as suitable for embankment will be made at the discretion of the Engineers where necessary on the basis of observations and tests in the field. These materials shall be obtained from excavations and the borrow areas and shall consist of gravel, sand, silt, and clay mixtures, considered suitable.

(G-2.8-9) The distribution and gradation of the materials shall be such that the embankment will be free from lenses, pockets, streaks or layers differing materially in

texture from the surrounding material. The materials entering the embankments shall be such that the finished fill will be as impervious as practicable. Any pervious material to be placed in the embankment shall be placed as directed by the Engineers and shall be placed only on the downstream face.

(G-2.8-10) The materials shall be of such nature that they will compact under proper manipulation into a solid, stable and essentially impervious embankment. They shall be free from wood, leaves, coal blossom, grass, muck, surface soil, roots, brush and other perishable matter and they shall not crack, slide or slough at the prescribed slopes after compaction.

(G-2.8-11) The operations in the borrow pits, excavations and placing shall be such as to produce the best mixture of materials available for the embankment. Whenever the formation varies materially due to strata, lenses, pockets, or other changes in formation, it shall be placed in the embankment in such manner as will most nearly produce the desired gradation.

(G-2.8-12) All large stone which may interfere with the rolling and compaction of the embankment material shall be removed. Any stones permitted in the embankment shall be separated one from another by earth and in no case allowed to collect in nests. In general, large stones shall be removed prior to rolling and compacting the materials and may be placed on the slopes or in the toe in a manner directed by the Engineers.

Embankment Foundation Preparation

(G-2.8-13) After the embankment foundation has been cleared, stripped and prepared in accordance with these specifications, the areas to be covered by the selected impervious fill shall be worked so that the surface shall be loosened to a depth of not less than 6 inches. All roots and debris shall be removed and a 3 inch layer of embankment material spread. Proper care shall be exercised and suitable means of roughening, moistening or otherwise shall be taken to provide a satisfactory bond between the embankment base and the fill material. The surface shall then be rolled as specified in a following paragraph. Stump holes shall be broken down with a bulldozer to flatten the side slopes and the holes shall be filled and thoroughly compacted in the same manner as specified for the embankment.

Protection

(G-2.8-14) While the design of the intake tower is such as to pass all ordinary flood waters, in the event of extraordinary floods, there exists the possibility that the embankments may be over-topped. To prevent excessive damage

to the structures or embankment, the Contractor shall keep the top of the embankment approximately level longitudinally so that any water flowing over the embankment will have a minimum depth and velocity. The Contractor shall be responsible for any damage caused to the dam or any of the structures during all stages of construction due to any wave action or as the result of floods or high waters and all such damage shall be repaired by the Contractor at no expense to the Owner. The Contractor shall determine the method which he proposes to use in connection with control of flood waters and the prevention of damage to the structures from the same. Such methods must be approved by the Engineers and the approval of such methods will not relieve the Contractor from full responsibility for any damage which may occur.

Spreading of Materials

(G-2.8-15) The Contractor may use any approved method of transporting the materials. After dumping, the material shall be spread in layers approximately 4 inches in thickness for compaction and then immediately rolled as hereinafter specified. Should the material, as dumped, be too high in water content to obtain the desired compaction, it shall be bulldozed and spread out and left for a sufficient time to allow the surplus water to dry out before being rolled. Before a new layer is placed, the surface of the previously rolled embankment will be inspected by the Engineers and, if additional water is required, it shall be added at this time. If the material has hardened from drying out, it shall be disced or scarified to a depth sufficient to cut through the dried material and dampened to its proper water content. Sufficient new material shall then be added to bring the layer to the specified thickness for rolling.

Moisture Control and Compaction

(G-2.8-16) The surface of the embankment shall have the proper water content required for compaction before additional material is placed. The quantity of water required for the rolled fill is that which will give the desired compaction under the rolling and hauling equipment. The Engineers will at all times be the judge as to whether or not the proper degree of compaction is being obtained. The watering shall be done with any suitable type of watering equipment, such as sprinkling carts or other approved equipment, but jets shall not be directed at the material with such force that the finer materials are washed out. Wetting shall be done in such a manner as to avoid the formation of pools and secure a uniform moistening of all parts of the fill.

(G-2.8-17) The Contractor shall be responsible for furnishing his own water for the project and may use water from the creek for sprinkling and packing operations and curing of concrete. He shall arrange for such pumping and distribution facilities as he may require.

(G-2.8-18) There shall be available at all times sufficient watering equipment to furnish the required water. When the moisture content is satisfactory to the Engineers, the Contractor shall roll the embankment with sheepsfoot type rollers. Each roller shall have tamping feet uniformly staggered over its cylindrical surface and shall be equipped with cleaners. Each tamping foot shall project approximately 7 inches from the roller's cylindrical surface and shall have a face area of not less than 5, nor more than 7 square inches. The spacing shall be such as to provide approximately three tamping feet for each two square feet of cylindrical surface. The total weight of the roller in pounds, divided by the total area in square inches of the maximum number of tamping feet in one row parallel to the axis of the roller shall not be less than 500 pounds with the roller weighted, nor less than 250 pounds with the roller empty. The design and operation of the tamping rollers shall be subject to the approval of the Engineers, and they shall have the right at any time during the work to require such repairs and minor alterations to the tamper feet and rollers as may be necessary to secure maximum compaction of the earth fill materials.

(G-2.8-19) The roller or sets of rollers shall be drawn by crawler type tractors at a speed not greater than 2-1/2 miles per hour. Each layer of the fill shall be compacted by means of not less than six complete trips of the roller, on Class "B" and Class "C" embankment and not less than ten complete trips of the roller on Class "A" embankment, or as directed by the Engineers. Successive trips of the roller shall not overlap, but the space between shall not be greater than the space between adjacent feet of the roller. Failure to comply with those requirements for careful rolling will be cause for requiring additional trips ~~at the Contractor's expense~~.

(G-2.8-20) Where newly placed material abuts old material in the embankment, the old material shall be cut or broken by discing, scarifying or bulldozing until it shows the characteristic color of undried material and the roller shall work on both materials, bonding them together. The water content for the required compaction is approximately that which gives a slight rebound under the construction equipment, but shows no tendency to rut or stick to the equipment or become wavy. Material which does not show a slight rebound will not be accepted as complying with these specifications. Where clearances are such that rolling equipment cannot completely consolidate the material other methods of compaction shall be used. Samples for testing all embankment materials, both before and after placement, will be taken at frequent intervals, and, from these tests, corrections and adjustments of methods and materials will be made as required by the Engineers.

APPENDIX VI-B
PREVIOUS INSPECTION REPORTS

19508 - UPPER NORTON RES.

November 29, 1956

BENGES BRANCH DAM AND RESERVOIR NEAR NORTON, VIRGINIA (ASF-923/58)

In accordance with verbal request and subject assignment, a field investigation was made September 25, 1956, by the writer and Mr. Boone. Personnel in the Norton City Manager's office were contacted (Mr. Phillip Davis, the City Manager being out of town) where details of the proposed dam were secured from a complete set of plans. Also, a visit was made to the dam site where clearing and foundation excavation work was being performed.

Location - The dam is located in Wise County, Virginia, about 0.6 mile south of the Norton city limits, on Benges Branch, 3 miles upstream from Powell River, and about 400 feet upstream from the present city water plant reservoir and as shown on the attached map, Plate 1.

Proposed Dam - The dam will be an earth fill structure with 2 1/2 to 1 downstream slope and 3 to 1 upstream slope with a crown width of 12 feet. The earth fill will be Class "A", "B", and "C" as shown on the attached drawing Plate 2. There will be an inspection trench, at center of fill along axis, excavated to a minimum depth of 2 1/2 feet into rock and 8 feet wide and as shown in Section B-B of Plate 2. The overall length of the dam will be about 340 feet and maximum height will be about 80 feet. The upstream face of the dam will be riprapped to a minimum depth of 15 inches.

November 29, 1956

BENGES BRANCH DAM AND RESERVOIR NEAR NORTON, VIRGINIA, (ASF-923/58)

In addition to the inspection trench and the Class "A" fill of core wall a steel pile cut-off wall, as shown on Section A-A of Plate 2, may be installed.

The elevation of top of dam will be 3292.5 (USC&GS, 1929 Adj.).

Spillways - The main or overflow spillway will be located at the left end of the dam as shown on general plan, Plate 2. This spillway consists of a concrete box inlet weir 62 feet long with a crest elevation of 3287.5, which leads into a concrete box culvert 10 feet wide and 15 feet high. The water from this culvert empties into an concrete trough 8 feet wide and 15 feet high. The elevation of the spillway trough outlet will be about 3215.

Also, there will be a 30 inch by 30 inch concrete box culvert at base of dam equipped with a gate and gate control tower. The culvert will have seep rings 8 feet by 8 feet and located at 8 feet C.C.

Elevations of Spillways:

Main - 62 feet inlet weir	= 3287.5
Trough outlet	= 3215±
Culvert - Inlet	= 3225.0
Outlet	= 3220±

November 29, 1956

BENGES BRANCH DAM AND RESERVOIR NEAR NORTON, VIRGINIA (ASF-923/58)

Reservoir and Drainage Area - The reservoir will cover an area of 6.4 acres at full pool elevation of 3287.5. The entire area below full pool elevation will be cleared of all timber and small growth.

The drainage area above the dam varies in elevation from 3225 to 4225, has a length of 1.5 miles, and has an area of 0.7 square mile or 450 acres.

The normal low water flow of Benges Branch at the dam site is less than one second foot.

Plans and Contract - The dam was designed and complete plans made by "The Chester Engineers", of Roanoke, Virginia.

The Slusher Corporation of Roanoke, Virginia are the general contractors, with W. R. Hammer of Norton being a sub-contractor.

Purpose of Dam and Reservoir - The dam is being built by the City of Norton, Virginia to create a storage reservoir to be used in conjunction with the existing reservoir and city water plant.

Downstream Features - Located directly downstream from the new dam is the existing city reservoir and water plant of the city. About 1.5 miles downstream from the new dam Benges Branch flows parallel to State Highway 73 for about 1500 feet where a few houses are located in the low

November 29, 1956

BENGES BRANCH DAM AND RESERVOIR NEAR NORTON, VIRGINIA (ASF-923/58)

bottom area. Also, located along the lower reaches of Benges Branch are several small bridges, one railway bridge, one U. S. Highway 23 bridge and one State Highway 73 bridge.

Summary of Main Features

Drainage Area	450 Acres
Reservoir Area (Full pool)	6.4 Acres
Elevations - Crest of Dam	3292.5
- Spillway weir	3287.5
- Box culvert	3225
Length of dam (At crest)	340 Feet
Maximum height	80 Feet
Maximum width at base	360 Feet
Crown width	12 Feet

William P. Clark

Attachments: Plates 1 and 2

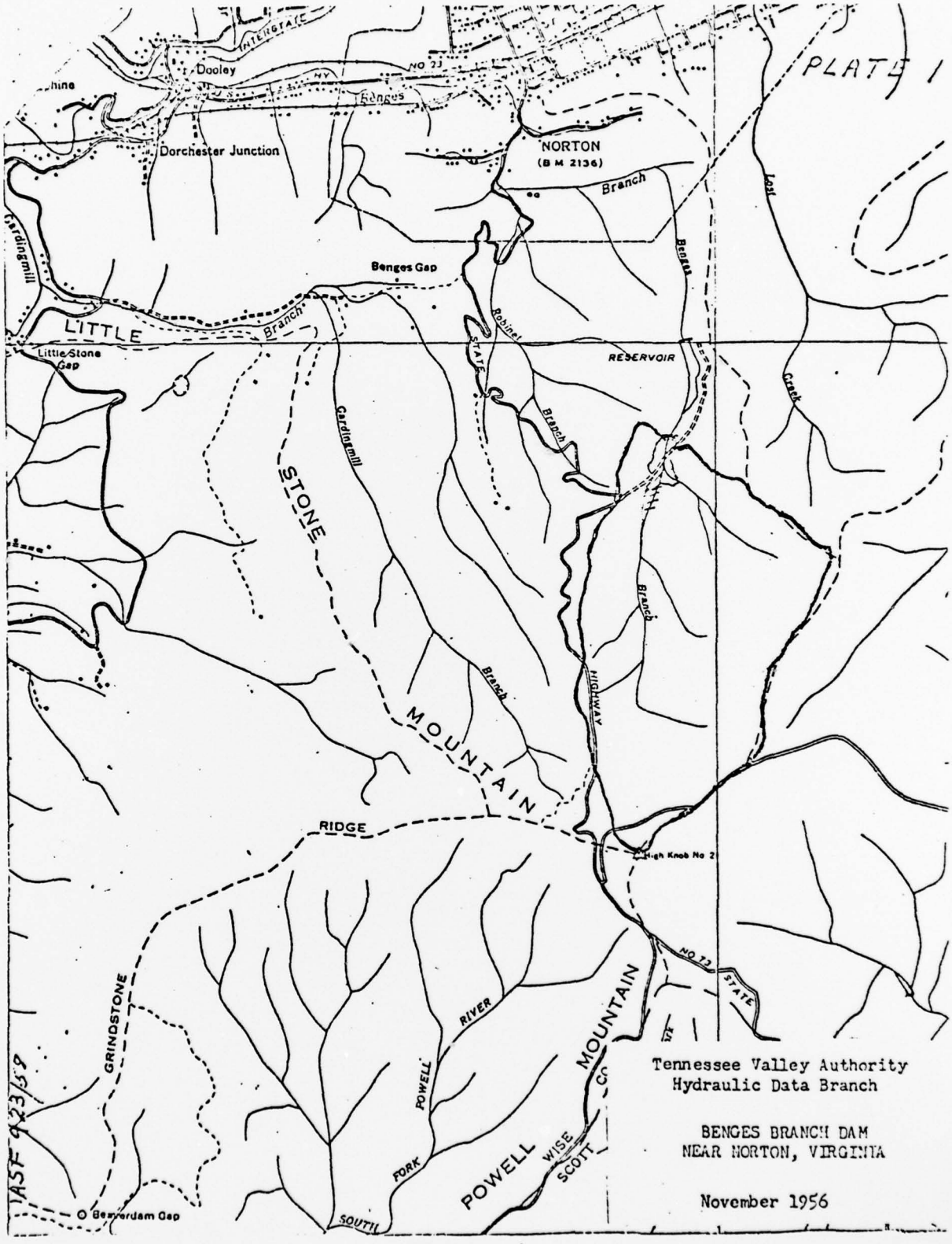


PLATE 1
INTERSTATE
Dooley
NO 23
NY
Fenges
Dorchester Junction
NORTON
(B M 2136)
Branch
Benges Gap
LITTLE
Branch
Little Stone Gap
STATE
RESERVOIR
Creek
STONE
MOUNTAIN
RIDGE
HIGHWAY
High Knob No 2
NO 23
STATE
GRINDSTONE
POWELL
RIVER
MOUNTAIN
FORK
POWELL
WISE
SCOTT
Tennessee Valley Authority
Hydraulic Data Branch
BENGES BRANCH DAM
NEAR NORTON, VIRGINIA
November 1956

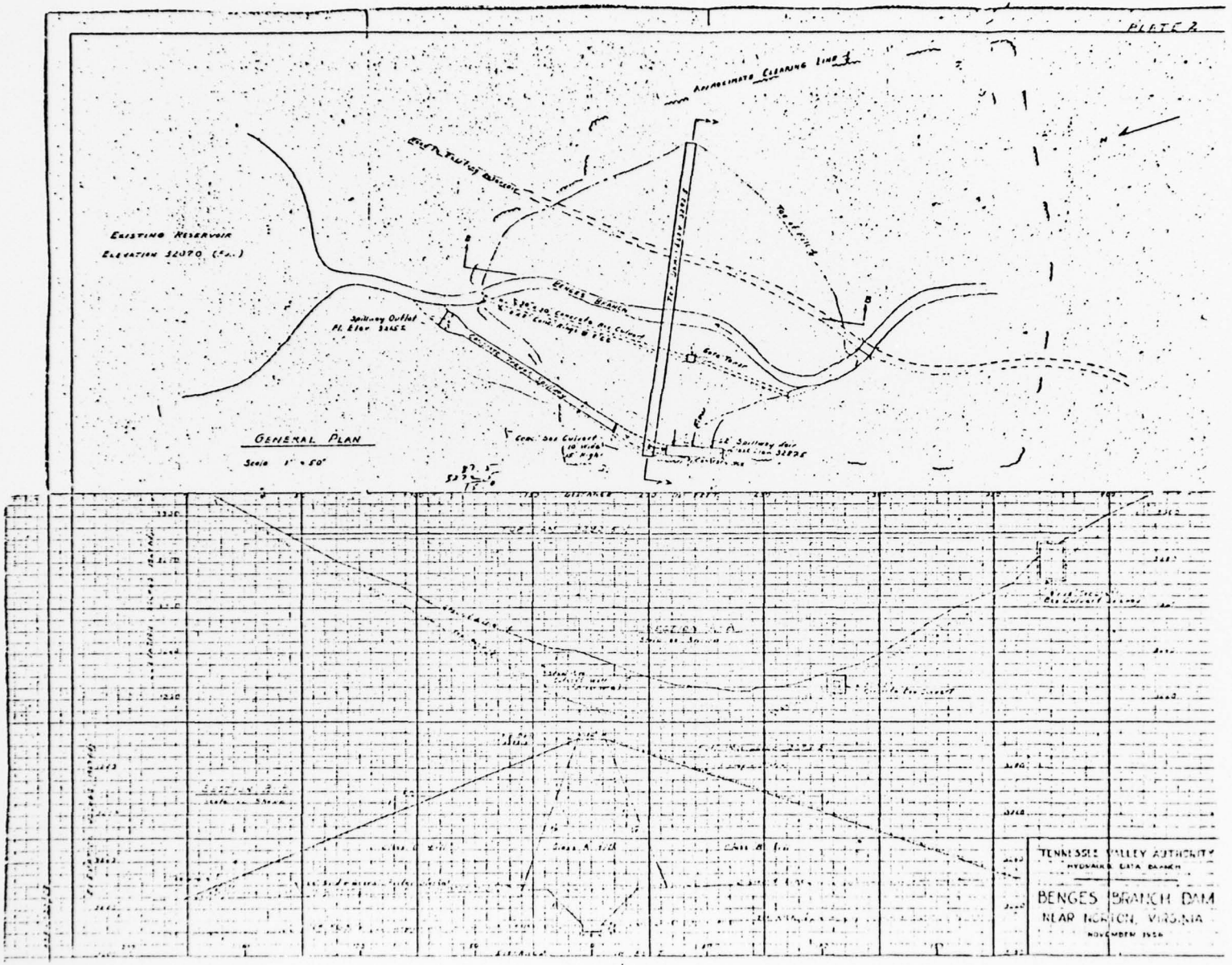


PLATE 2
Approximate Clearing Line
Existing Reservoir
Elevation 32070 (Est.)
Benges Branch
Spillway Outlet
Pl. Elev. 32452
Gate Tower
General Plan
Scale 1" = 60'
TENNESSEE VALLEY AUTHORITY
HYDRAULIC DATA BRANCH
BENGES BRANCH DAM
NEAR NORTON, VIRGINIA
NOVEMBER 1958

APPENDIX VII

REFERENCES

APPENDIX VII

REFERENCES

1. Recommended Guidelines for Safety Inspection of Dams, (Washington, D.C., Department of the Army, Office of the Chief of Engineers).

2. Earthquake History of the United States, Publication 41-1, (Washington, D.C., U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Environmental Data Service), 1973.

3. HEC-1 Flood Hydrograph Package, (Hydrologic Engineering Center, U.S. Army Corps of Engineers, January 1973).

4. Design of Small Dams, (U.S. Department of the Interior, Bureau of Reclamation, Second Edition, 1973).

5. "Seasonal Variation of the Probable Maximum Precipitation East of the 105th Meridian," Hydrometeorological Report No. 33, (U.S. Weather Bureau, April 1956).

6. "Rainfall Frequency Atlas of the United States," Technical Paper No. 40, (U.S. Weather Bureau, May 1961).

APPENDIX VIII

CONDITIONS

APPENDIX VIII

CONDITIONS

This Report is based on a visual inspection of the dam, a review of available engineering data, and a hydrologic analysis performed during a Phase I investigation as set forth in the U.S. Corps of Engineers' Recommended Guidelines for Safety Inspection of Dams and the contract between the U.S. Corps of Engineers and Gilbert Associates, Inc.

The foregoing inspection, review, and analysis are by their nature limited in scope. It is possible that conditions exist which are hazardous, or which might in time develop into safety hazards, that are not detectable by this inspection, review, and analysis. Accordingly, Gilbert Associates, Inc. cannot and does not warrant or represent that conditions which are hazardous, or which may in time develop into safety hazards, do not exist.